SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, DECEMBER 2, 1898.

CONTENTS:

The Association of American Agricultural Colleges and Experiment Stations: A. C. TRUE.....761
Thermal Efficiency of Steam Engines: PROFESSOR R. H. THURSTON.....764
The Kinetic Theory of Gases and Some of its Consequences: PROFESSOR WILLIAM RAMSAY.....768
On Some Analogies between the Physiological Effects of Lack of Oxygen, High Temperature and Certain Poisons: DR. WILLIAM ZOETHOUT.....776
Leidy's Genus Ouramœba: PROFESSOR WILLIAM L. POTEAT.....778
New Names for Spermophilus brevicaudus, Canis pallidus and Sorex caudatus Merriam: DR. C. HART MERRIAM; *for Microtus insularis Bailey:* VERNON BAILEY; *for Sciurus albipes quercinus Nelson:* E. W. NELSON.....782
Professor James Ingraham Peck: PROFESSOR H. C. BUMPUS.....783
Notes on Inorganic Chemistry: J. L. H.....783
Current Notes on Meteorology:—
August Hot Wave in California; Monthly Weather Review; Notes: R. DEC. WARD.....785
Botanical Notes:—
Some More Atrocious Botany; Western Weeds; The Economic Grasses of the United States.....785
Current Notes on Anthropology:—
Influence of Sex on Crime; The Progress of Anthropology; A Neolithic Lady: PROFESSOR D. G. BRINTON.....787
Scientific Notes and News.....788
University and Educational News.....791
Discussion and Correspondence:—
Shall the International Equivalent of 'Anlage' be Primordium or Proton: PROFESSOR BURT G. WILDER. *Post-glacial Connecticut:* MARK S. W. JEFFERSON.....793
Scientific Literature:—
Helmholtz's Handbuch der physiologischen Optik: PROF. J. MCKEEN CATTELL. *Atkinson's Elementary Botany:* PROF. CONWAY MACMILLAN.....794
Scientific Journals.....798
Societies and Academies:—
Boston Society of Natural History: SAMUEL HENSHAW. *Biological Society of Washington:* F. A. LUCAS. *Geological Club and Conference of Harvard University:* J. M. BOUTWELL.....799
New Books.....800

THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

THE Association of American Agricultural Colleges and Experiment Stations, which held its twelfth annual convention at Washington, D. C., November 15th–17th, includes in its membership many of the State universities and scientific institutions in which instruction in many technical lines besides agriculture is carried on. It is a delegate body, each college being represented by its president or other officer, and each agricultural experiment station by its director or some other member of its expert staff. The institutions represented in this Association employ over 1,500 persons in their faculties, who are giving instruction to about 30,000 students. These institutions have over $50,000,000 in permanent endowments, buildings and equipment, and an annual revenue of nearly $6,000,000, of which more than $2,000,000 is derived from funds granted by the United States. Besides the work of instruction, they are carrying on original research in different directions. This is especially true in many scientific lines relating to agriculture, over a million dollars being spent for this purpose annually. There are now pending in Congress propositions to establish, in connection with these institutions, experiment stations for investigations in mechanic arts and naval engineering, for which some of

the colleges already have considerable facilities. The convention just closed was attended by delegates from every part of the country, and was regarded as a very successful meeting.

The annual address of the President of the Association, Dr. H. C. White, President of the Georgia State College of Agriculture and Mechanic Arts, was an unusually eloquent and able presentation of the breadth and strength of the education given along scientific and industrial lines in many of our land-grant colleges. He showed how 'the scholar' was the product of such education just as truly as of institutions built on classical foundations. He also pointed out that these institutions, which derive their support so largely from the United States Treasury, together constitute a great national university. The address thus furnished an appropriate introduction to the discussion of one of the most important topics taken up by the convention. There is a strong feeling among these institutions that the facilities for graduate study which are embraced in the great libraries, museums and scientific laboratories of the Government at Washington should be open to their students. A year ago the Association appointed a committee "to devise a plan whereby graduate students of the land-grant and other colleges may have access to, and the use of, the Congressional Library and the collections in the Smithsonian Institution, the National Museum and the scientific bureaus of the various Departments, at Washington, of the United States Government, for the purpose of study and research." This committee consisted of President Northrop, of the University of Minnesota; Secretary Cope, of Ohio State University; President Buckham, of the University of Vermont; President Ellis, of the State Agricultural College of Colorado; Chancellor McLean, of the University of Nebraska; President J. H. Washburn, of the Rhode Island College of Agriculture and Mechanic Arts. The committee, after a careful personal examination of the conditions in the different Departments at Washington, presented a report at this meeting of the Association, which included a recommendation that Congress be asked to pass the necessary legislation to organize a bureau of graduate study, preferably in the Smithsonian Institution, through which students from American colleges may have open to them the vast accumulations of scientific and other material for study existing at the National Capital. It was urged that this could be done at comparatively little expense, and that the high standing of the Smithsonian Institution in the scientific world, and its conservative organization, would enable it to carry on this work in a most creditable and satisfactory manner. The report was heartily endorsed by the Association, and the committee was instructed to make every effort to secure the necessary legislation at an early day. In this connection it may be interesting to note that it is the expressed intention of the Secretary of Agriculture to include in his forthcoming annual report a recommendation that the scientific divisions of the Department be open to a limited number of graduate students who will be admitted as the result of a competitive test, probably under the Civil Service Commission, and who may in some cases receive limited compensation for such services as they may render the Department in connection with their researches.

Another topic which attracted great interest at the meeting was the problem of more thoroughly organizing the military instruction which, under the law, is given in the institutions included in the Association. An able paper on this subject was read by President C. W. Dabney, Jr., of the University of Tennessee. In this paper, which received the hearty endorsement of the Association,

Dr. Dabney urged that the Government take steps to recognize these institutions more fully as agencies for the training of the officers who will be needed for our increased military establishment. A considerable number of the graduates of these institutions served with distinction in the war just closed, and there is good reason to believe that in the reorganization of our volunteer army it will be necessary to look to these institutions very largely for the trained material needed to put the volunteer army on a more efficient basis.

A notable paper was read by President A. W. Harris, of the University of Maine, on the relations of the churches to State colleges and universities. The author thought the different denominations should make some special provision at these colleges for students of their membership by building dormitories and chapels, and by organizing special courses of instruction in the immediate vicinity of the State college. In the discussion which followed, it was generally held that the churches might safely be left to promote their own interests through the agencies for church activity which are common in American communities.

The committee on methods of teaching agriculture presented its third report of progress, in which it gave a syllabus for a course of instruction in agronomy (plant production). The committee on indexing agricultural literature presented a library classification of agriculture (in its narrower technical sense) devised by Mr. W. P. Cutter, Librarian of the Department of Agriculture. The committee appointed by this Association to cooperate with the committee from the Association of Official Agricultural Chemists on uniformity in fertilizer laws brought in a schedule of twenty points, which both committees agreed were suitable for incorporation in the laws of the several States. By a very decisive vote the Association rejected propositions for the amendment of the constitution of the Association which looked to the abolition of the sections or their reduction in number. Meetings of all the sections were held during this convention and a number of interesting papers were read. Among the subjects most earnestly discussed were the inspection of nursery stock for the repression of insect and fungus enemies, and horticultural nomenclature.

The following officers of the Association were elected for the ensuing year: President, H. P. Armsby, Director of the Pennsylvania State College Agricultural Experiment Station; First Vice-President, J. E. Stubbs, President of the Nevada State University; Second Vice-President, C. S. Murkland, President of the New Hampshire College of Agriculture and the Mechanic Arts; Third Vice-President, J. L. Snyder, President of the Michigan Agricultural College; Fourth Vice-President, P. H. Mell, Director of the Agricultural Experiment Station of the Agricultural and Mechanical College of Alabama; Fifth Vice-President, F. P. Anderson, Professor of Mechanical Engineering of the Agricultural and Mechanical College of Kentucky; Secretary and Treasurer, E. B. Voorhees, Director of the New Jersey Agricultural Experiment Stations; Bibliographer, A. C. True, Director of the Office of Experiment Stations of the U. S. Department of Agriculture; Executive Committee: H. H. Goodell, President of Massachusetts Agricultural College; Alexis Cope, Secretary of Ohio State University; J. H. Washburn, President of the Rhode Island College of Agriculture and Mechanic Arts; W. M. Liggett, Director of the Agricultural Experiment Station of the University of Minnesota.

The following is a list of the papers read before the sections:

Section on College Work: 'Some Recent Changes in the Theory of Education,' E. A. Bryan, President

of the Washington Agricultural College and School of Science. 'Relations of the Churches to State Colleges and Universities,' A. W. Harris, President of the University of Maine.

Section on Mechanic Arts: 'What Preparatory Work should be Required to enter Four-Year Engineering Degree Courses,' O. L. Waller, Professor of Mathematics and Civil Engineering of the Washington Agricultural College and School of Science. 'Engineering Standard in Land-Grant Colleges,' W. H. Williams, Professor of Mechanical Engineering and Mathematics of the Montana College of Agriculture and Mechanic Arts.

Section on Horticulture and Botany: 'Laboratory Methods in Teaching Horticulture,' L. C. Corbett, Professor of Horticulture of the West Virginia University. 'Relation of Rainfall to Fungus Diseases,' B. D. Halsted, Professor of Botany and Horticulture of Rutgers Scientific School. 'Testing of Fruits by the Experiment Stations,' S. M. Emery, Director of the Montana Agricultural Experiment Station. 'Technical Training in Teaching Horticulture,' S. B. Green, Professor of Horticulture of the University of Minnesota. 'Preliminary Report of the Committee for the Testing of Races of Peaches,' R. H. Price, Professor of Horticulture, Botany and Entomology of the State Agricultural and Mechanical College of Texas

Section on Entomology: 'Entomology in Agricultural Colleges,' E. E. Faville, Professor of Horticulture and Entomology of Kansas State Agricultural College; S. A. Forbes, Professor of Zoology of the University of Illinois; H. Osborn, Professor of Zoology and Entomology of Iowa State College of Agriculture and Mechanic Arts; L. Bruner, Professor of Entomology of the University of Nebraska. 'A Fungus Disease of the San José Scale,' V. H. Lowe, Entomologist of the New York Agricultural Experiment Station. 'The Teaching Function of the Station Worker,' J. B. Smith, Professor of Entomology of Rutgers Scientific School. 'The Influence of Nature-Studies in Schools upon the Biology of the College Curriculum,' C. M. Weed, Professor of Zoology and Entomology of New Hampshire College of Agriculture and Mechanic Arts.

Section on Agriculture and Chemistry: 'Clover, Phosphates, and Wheat in Ohio,' W. I. Chamberlin, of Ohio. 'Productivity as affected by Tillage, I. P. Roberts, Director of Cornell University Agricultural Experiment Station. 'The Maintenance Ration of Cattle,' H. P. Armsby, Director of the Pennsylvania State College Agricultural Experiment Station. 'The Mission of the Agricultural and Mechanical Colleges and Stations from the Standpoint of the Agriculturist,' J. S. Newman, Professor of Agriculture of Clemson Agricultural College. 'Upon the Possibilities of drawing Erroneous Conclusions from Plant Soil Tests designed as Guides to the Economical Manurial Treatment of Soils, and to serve as a Basis for the Development of Reliable Chemical Methods for ascertaining their Requirements,' H. J. Wheeler, Chemist of the Rhode Island Agricultural Experiment Station. 'The Significance of Stock-Feeding Experiments,' C. F. Curtiss, Director of the Iowa Agricultural Experiment Station. 'Notes on Butter Tests of Cows, M. A. Scovell, Director of the Kentucky Agricultural Experiment Station.

A. C. True.

Washington, D. C.
November 22, 1898.

THERMAL EFFICIENCY OF STEAM-ENGINES.

A committee of the British Institution of Civil Engineers, composed of recognized authorities, has recently made a report, now published by the Institution, on the above subject, in which is proposed a standard and consistent scientific scheme for the treatment of thermal and thermodynamic quantities in the discussion of the experimentally determined efficiencies of the steam-engine. It is so important a document that we give space to a somewhat liberal abstract and summary of the conclusions of the committee.*

An introduction by the Secretary, Captain H. R. Sankey, gives a technical definition of the 'steam-plant' and points out the differences, the wastes, which distinguish the ideal and the real heat-engines. These differences are illustrated by an exceedingly interesting and helpful diagram in which the energy-flow is traced from its source in the fire-box of the boiler through the boiler and its contents of steam and water, on the one hand, for use in the engine, and, on the other hand, to the chimney as a waste. It exhibits the methods, extent and character of the wastes of thermal, of dynamic and of thermodynamic

* Report of the Committee appointed to consider and report to the Council upon the subject of the Definition of a Standard of Thermal Efficiency.—London, Published by the Institution, 1898.

phenomena in the engine as well as at the boiler, and exemplifies the case by making the diagram a correct measure, drawn to scale, of the performance of a famous steam pumping engine.

All the required data for exhibition of this flow of the energies through a heat-engine are secured and recorded in every well conducted and complete engine-trial, and ample data are now available for its illustration. One of the best of recent reports upon the performance of the exceptionally economical Leavitt engine at the Louisville, Ky., water works has been diagrammed in this manner by Captain Sankey, to make clearly understood the principles and the facts involved in the discussion of the 'thermal efficiency of steam-engines,' by this committee of the British Institution of Civil Engineers. This diagram is here reproduced, from that report, published as above. In this instance, every known precaution against waste of heat has been taken, and all the conditions, thermal, thermodynamic and dynamic, are in unusual degree favorable to a high resultant efficiency. The case is, therefore, a very exceptionally good illustration of thermodynamic action, and the wastes are much smaller than are commonly observed in the operation of even good classes of steam-engine.

"The broad river of heat, generated by the burning coal on the grate, is shown flowing to and through every part of the apparatus, losing by radiation at every step, and finally emerging at the chimney, in a flow of heated air and gases, and at the condenser, in the circulating water discharged, and at the engine-shaft as useful work." All of this broad river of heat arises from a source within the fuel bed, flows through its delta of narrower channels, mainly to waste, and it all finally emerges into the great sea of heat, the external atmosphere, as thermal energy; even the useful work being sooner or later retransformed into heat by friction, whether of engine or of work performed by the machine. Were our diagram to give the further history of these flows of energy it would show a cycle in which the external currents circulate from the engine into the atmosphere, into potential forms, once more, by retransformation into the stored energy of chemical affinities, through the ever-active influence of vegetation, later to be possibly again employed in other heat-engine cycles, when once more resurrected as potential energy of fuel.*

The diagram here reproduced is drawn to a scale, and quantities of heat, and temperatures as well, are shown at each step in the progress of the heat flow, from fuel to outer atmosphere and to the drainage channels of the country. The following verbal description may properly accompany the graphic story:

At the start, 183,600 B. T. U. per minute is the measure of the energy liberated in active form from its original, potential, condition in the fuel. Of this energy, 131,700 B. T. U. pass into the water and steam and are there stored as thermal energy, available for thermodynamic operations; 41,900 go toward chimney and economizer; 10,000 flow out of the system, as waste, through condition and radiation in the flow between boiler and economizer, 5,000 more at the economizer, and 15,750 are taken into the feed-water within the economizer and thus utilized. The balance, 20,150, get through the economizer and flow up chimney and thus into the outer air and are lost to the thermodamic system.

The economizer receives 5,450 B. T. U. from the feed-water coming from the engine and 15,750 from the furnace-gases;

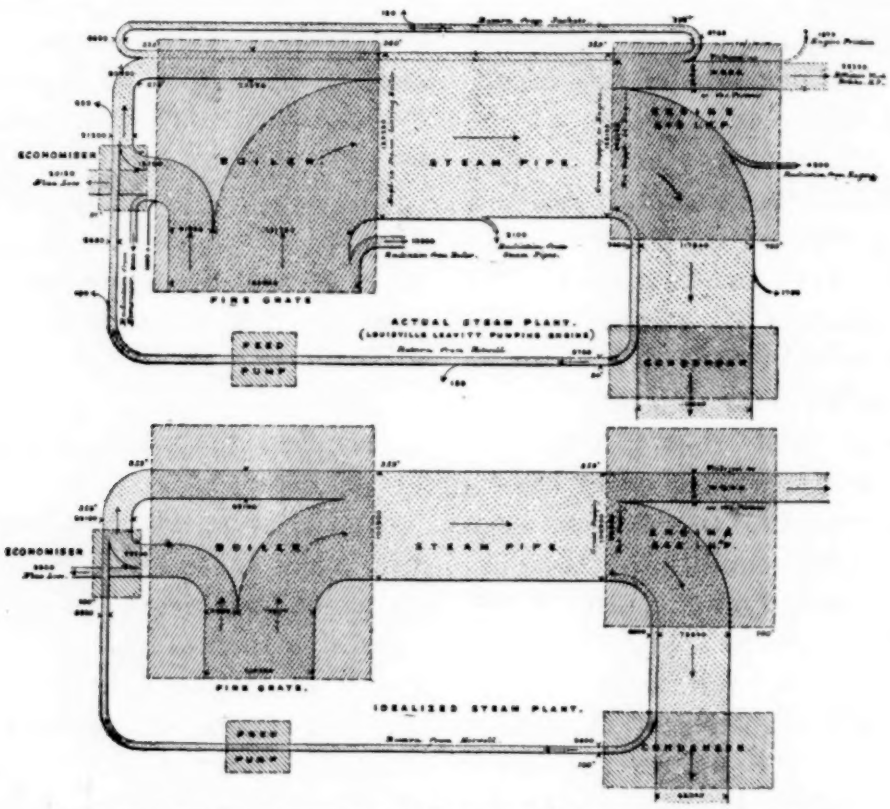
* For original data of the case here taken, see Trans. Am. Society Mechanical Engineers, Vol. XVI., *Engineering News*, December 13, 1894. Proc. Brit. Inst. C. E., 1898.

sending the total, 21,200, toward the boiler; for use there; losing, however, 250, *en route*, and giving up the remainder, 20,950, together with the heat of jacket-water, joining the stream at the boiler, to reduce the demand for and cost of fuel, by raising the temperature of the water to be converted into steam.

The flow to the engine from the boiler begins with a stock of 169,350 B. T. U. per minute, but 3,100 are lost on the way by conduction and radiation and by leakage from the steam pipes, and the engine actually receives a balance of 156,150 B. T. U. per minute. Of this, 7,400 go back in the feed-water and 6,600 from the jackets, making the net supply 142,150 B. T. U. per minute.

Of this net supply, only 27,260 are reported to have been transformed into mechanical energy, to flow through the engine and perform work, useful or other. The efficiency of this operation is, therefore, but 27,260 / 142,150 = 0.15, fifteen per cent. This is called the 'Thermal Efficiency of the Engine,' perhaps more correctly *Thermodynamic Efficiency of the Engine*. The indicated power is reported as 643 H. P. and the demand for heat at the piston is thus 221 B. T. U. per I. H. P. per minute.

Engine-friction absorbs work to the equivalent of 1,870 B. T. U. per minute, and this gives 25,390 B. T. U. as the equivalent of the net, usefully applied, work of the engine, and this gives us 237 B. T. U. per minute as the consumption of energy per D. H. P., a measure of the 'brake efficiency,' as it is sometimes called.



Losses and Transfers of Heat in Steam-power Plants.

The second of the two figures here represented, on the lower portion of the plate, illustrates the ideal case, the ideal steam-engine delivering the same quantity of 'indicated' power, and differing from the real engine by operating in the 'Rankine Cycle,' and in exhibiting no wastes by clearance or friction, conduction or radiation—

a purely thermodynamic case. At the boiler, also, there are no losses by conduction or radiation and the flue-gases are reduced to the temperature of the steam in the boiler before discharge.

Of the total heat developed in the furnace, now only 104,200 B. T. U., the large proportion, 31,400, are still wasted by way of the chimney, since the gases must be sent out at least as hot as the boiler-steam. The quantity sent to the engine is 72,800, to which is added the saved heat from the economizer, here also assumed to be employed, 28,100 B. T. U. The engine receives, thus, a total of 100,900 B. T. U. per minute, of which 5,600 is returned by way of the feed-pipe, giving a net supply of 93,300 for the thermodynamic cycle. This amounts to 148 B. T. U. per I. H. P. per minute, equivalent to an efficiency of 0.285. The ideal thus demands but 0.67, two-thirds the heat-supply of the actual engine.

This graphical analysis has special interest in connection with the employment of the engine-trial data in the calorimetric analysis of Hirn for detection and measurement of thermodynamic and other defects of the actual engine cycle. Where the jacket is employed, it is to be understood that the process of the flow of heat from the jacket-steam into the wall of the engine-cylinder is a continuous and uniform operation; but that the method and rate of flow from metal to steam, within the cylinder, is irregular and its precise law unknown.

The work of the Committee results in the recommendation that the thermal economical value of steam-engines should be stated in thermal units per indicated horse-power. It takes the so-called Rankine standard cycle—a thermodynamic cycle with isothermals as upper and lower limiting boundaries and with complete adibatic expansion and without clearance of compression—as the standard of comparison, the unit of thermodynamic efficiency with which to compare the efficiency of the real engine, and describes the method of testing and recording results of test and the forms of computation required in affecting this comparison of the ideal with the real case.

The ideal, Rankine, cycle was first proposed by that writer in 1854 in a paper published in Transactions Royal Society of Edinburgh, as of date of January 19, 1854. The paper was reproduced in the 'Miscellaneous Papers of Rankine,' page 400, section 46. Clausius described the same cycle in Poggendorff's Annalen, 1856, and later in his 'Mechanical Theory of Heat,' quite independently, however, of Rankine, of whose work he was at the time unaware.*

The following are the summarized recommendations of this committee, and it is recommended by them that authors presenting papers to the British Institution of Civil Engineers be invited to conform to these suggestions:

(1) That 'thermal efficiency' as applied to any heat-engine should mean the ratio between the heat utilized as work on the piston by that engine and the heat supplied to it.

(2) That the heat utilized be obtained by measuring the indicator diagrams in the usual way.

(3) That in the case of a steam-engine the heat supplied be calculated as the total heat of the steam entering the engine less the water-heat of the same weight of water at the temperature of the engine exhaust, both quantities being reckoned from 32° F.

(4) That the temperature and pressure limits, both for saturated and heated steam, be as follows:

Upper limit: the temperature and pressure close to, but on the boiler side of the engine stop-valve, except for the purpose of caculating the standard of comparison in

* Hirst's Translation of Clausius, 1867, page 161. This note, however, does not appear in the German edition of 1876.

cases when the stop-valve is purposely used for reducing the pressure. In such cases the temperature of the steam at the reduced pressure shall be substituted. In the case of saturated steam the temperature corresponding to the pressure can be taken.

Lower limit: the temperature in the exhaust-pipe close to, but outside, the engine. The temperature corresponding to the pressure of the exhaust steam can be taken.

(5) That a standard steam-engine of comparison be adopted, and that it be the ideal steam-engine working on the Rankine cycle between the same temperature and pressure limits as the actual engine to be compared.

(6) That the ratio between the thermal efficiency of an actual engine and the thermal efficiency of the corresponding standard steam-engine of comparison be called the efficiency ratio.

(7) That it is desirable to state the thermal economy of a steam-engine in terms of the thermal units required per minute per Indicated HP., and that, when possible, the thermal units required per minute per Brake HP. be also stated.

(8) That, for scientific purposes, there be also stated the thermal units required per minute per HP. by the standard engine of comparison, which can readily be obtained from a diagram similar to that given, and from which the efficiency ratio can be deduced.

R. H. Thurston.

---

*THE KINETIC THEORY OF GASES AND SOME OF ITS CONSEQUENCES.**

Though Science—Science with a capital S—is often contrasted with Art—Art with a capital A; though the former is held to be dry and unattractive, while the latter stirs the imagination and arouses 'thoughts that breathe and words that burn;' yet the follower of science now and then is rewarded for his toil by an ordered sequence which appeals to the imaginative side of his nature, no less than the rhythmic harmony of poetry, or the measured cadences of music. Indeed, it is not impossible for the poet to express better than, and as truly as in the pages of the *Philosophical Transactions*, the highest generalizations of science. In this Tennyson stands unrivalled. Take, for example, the stanzas:

"There rolls the deep where grew the tree,
O earth, what changes hast thou seen!
There where the long street roars, hath been
The stillness of the central sea.

"The hills are shadows, and they flow
From form to form, and nothing stands;
They melt like mist, the solid lands,
Like clouds they shape themselves and go."

It contains an epitome of the whole of geology. The science is mere elaboration of the ideas contained in Tennyson's beautiful verses.

The difficulty in gaining the appreciation of the 'general public' is in presenting the ideas in intelligible language. That the scientific and the romantic are sometimes closely intermingled is indisputable; but the romance is one which appeals to few. In the following pages an attempt will be made to show how the thoughts of many men, each striving to 'increase natural knowledge,' as the formula of admission to the Royal Society runs, have led to a discovery of some interest—that of a hitherto unsuspected constituent of atmospheric air.

The Roman poet Lucretius, a friend and contemporary of Cicero, was the author of a poem entitled 'De Rerum Naturâ' ('On the Nature of Things'). In this poem, which treats of almost all things in heaven and earth, he argues that the atoms, the existence of which is obvious because one sees them in a cone of light passing through a dark room, fall rapidly together in their dancing course throughout the spheres,

* Reprinted from the *Contemporary Review* for November, 1898.

and by their collision engender all known things. Their paths are, however, not directed, but fortuitous; and, therefore, the world is the product of chance.

Passing over many centuries, we find Boyle, in the reign of Charles II., suggesting that the difference between different kinds of matter is to be explained by the nature and the motion of the particles or atoms of which they are composed. The region of speculation was narrowed when Daniel Bernoulli, in 1738, attempted to account for the law, due to Boyle, that the volume of gases varies inversely with the pressure to which they are exposed; and similar attempts were made by Herapath in 1821, and by Joule in 1851. Their ideas were systematized by Clausius in 1857 under the name of the 'Kinetic Theory of Gases.'

Briefly stated, the theory is this: Granted that in gases the particles—or, as they are now termed, the molecules—of which they consist are widely separated from each other, and that the pressure which the gas exerts on the sides of any vessel in which it may be confined—a pressure which may be realized by pumping away the air outside the vessel, when, if the vessel is constructed of yielding material, such as bladder, it will distend, and ultimately burst—is caused solely by the bombardment of the molecules of gas on the walls. It is at the first blush not very easy to conceive of a steady pressure being due to an enormous number of impacts irregularly delivered. But there are many analogies which help to form the conception. For instance, a musical note, which may strike us as of the utmost smoothness and uniformity, is in reality the result of a succession of blows on the tympanum of the ear, each following the preceding one too rapidly for our ears to distinguish the break in continuity. In a similar manner the pressure of a gas is accounted for. And the temperature, a rise in which also increases the pressure of a gas on the walls of a vessel containing it' is attributed to the increased velocity of the molecules of the gas. Now, for simplicity's sake, considering a blow given by only one molecule, the force of the blow—to use a rough expression which will serve the purpose—will depend not merely on the rate at which that molecule is moving, but also on the weight of that molecule. So that a light molecule with a high rate of motion may deliver as forcible a blow as a heavy molecule with a slower rate of motion. By Clausius's hypothesis the temperatures of two gases are believed to be equal when the products of their masses into the square of their rates of motion are equal. This is not quite the same thing as saying 'when the force of the blows they give is equal,' but it may be taken as connected with it.

Supposing, then, that two gases are at the same temperature—that when placed in contact neither gives up heat to the other—then the product above mentioned must be equal for both. For it is obvious that the specifically lighter gas must have the higher velocity; that is, the molecules must be endowed with a higher rate of motion.

What is that rate of motion? Clausius was able to answer that question: A molecule of hydrogen, the lightest gas known, if it moved in a straight line, unimpeded in its motion by collison with any other molecules or with any solid body, would pass through no less than a mile and a quarter in a second. And a molecule of oxygen equally free to move would travel through space with a velocity of rather less than one-third of a mile per second. The relative rates of motion are, therefore, in inverse proportion to the square roots of the densities of the gases. Thus, as oxygen is sixteen times as heavy as hydrogen, a molecule of hydrogen would move through space in a straight line, were it free to do so, at a rate four times as great as that at which a molecule of oxygen moves.

These rates of motion are calculated for the temperature of melting ice. But as the effect of rise of temperature is to quicken the rate of motion of molecules of gases, so fall of temperature will cause a decreased velocity. The question arises: Is there any possibility of so lowering temperature that the motion of such moving molecules will cease? Judging by the rate at which the pressure of a gas decreases with fall of temperature, there is: That temperature has been called the 'absolute zero of temperature;' it lies 273° below the melting point of ice on the Centigrade scale, or at —460° on the Fahrenheit scale, the one commonly in use in this country. This temperature has not been reached; it is unlikely that it will ever be reached; but an approach has recently been made to it by liquefying hydrogen gas and allowing it to boil at the atmospheric pressure. The temperature reached in this manner is about —243° Cent.; and Professor Dewar, who has recently succeeded in liquefying hydrogen in quantity, will no doubt be able to produce a still lower temperature, by causing the liquid hydrogen to boil in a vessel connected with an air pump, so that the pressure is reduced. For just as raising the pressure raises the boiling point of a liquid, as exemplified in the boiler of a steam engine, so lowering the pressure lowers the boiling point.

It is now many years since Dr. Johnstone Stoney applied the Kinetic Theory of Gases, in a series of papers read before the Royal Dublin Societies, to the question of the existence of atmospheres on planets and satellites. If a molecule happens to be moving on the surface of a planet at a rate which would carry it away from the planet more rapidly than the planet can draw it back, that molecule will escape into space. It is not theoretically impossible, although practically unrealizable, to construct a gun which would fire a bullet vertically into the air at such a rate that the bullet might never return to the earth. What, then, would occur to it? Well, it would wander on through space as a little planet, performing an ellipse round the sun, as indeed many aërolites, or 'shooting stars,' are known to do. It might, indeed, chance to come within the range of attraction of some planet—*e.g.*, Jupiter—massive enough to hold it; or it might actually fall on the surface of a planet; in the former case it would act like a little satellite and revolve round that planet, as the numerous stones of which Saturn's rings are composed revolve round Saturn; in the latter case it would simply become part of that planet, as the falling stars which reach the earth form, after their fall, a portion of the earth.

The molecule of gas, which we have been considering, differs in no particular from a bullet, in its wanderings or in its fate. If it chance to come within the sphere of attraction of a planet of sufficient mass to retain it, it will, according to Dr. Stoney, form part of that planet's atmosphere. If not, it will wander on until it may, by chance, come near enough to the sun to fall a victim to its enormous attractive force, and it will then become part of the sun's atmosphere.

Dr. Stoney has summed up the results of various inquiries of this kind in a memoir, entitled 'Of Atmospheres upon Planets and Satellites.'*

One important point has been omitted in the sketch given of the Kinetic Theory. It is this: When it was said that a molecule of oxygen moves at the rate of about one-third of a mile per second it was not implied that all molecules are moving at that rate. Some, urged on by collisions from behind, acquire a much more rapid rate; others, hindered in their motion by collisions with other molecules moving more

* 'Royal Dublin Society,' Vol. VI., Nov., 1897, pp. 305–328.

slowly than themselves, or in opposite directions, have their rate of motion decreased. A gas must be conceived as composed of an almost infinite number of such molecules, jostling each other in every conceivable way. The rate of one-third of a mile per second, deduced by Clausius as the average rate of motion of a molecule of oxygen, must be understood to mean that, if all the rates of motion were to be balanced out, so that the swiftly-moving molecules gave up some of their motion to the slowly-moving molecules, and *vice versa*, the molecules would all be moving at the above-mentioned rate. But it must be distinctly borne in mind that this imaginary state of things never occurs. There are always many molecules moving faster, many slower, than the average.

I find, in my own case, that it helps greatly to a clear understanding of such a conception as that of which a short account has been given, if a mental picture can be called up which will illustrate the conception, although even imperfectly. Some such picture may be formed by thinking of the motions of the players in a game of football. At a critical point in the game the players are running, some this way, some that; one has picked up the ball and is running with it, followed by two or three others; while players from the opposite side are slanting towards him, intent upon a collision. The backs are at rest, perhaps; but on the approach of the ball to the goal they quicken into activity, and the throng of human molecules is turned and pursues an opposite course. The failure of this analogy to represent what is believed to occur in a gas is that the players' motion is directed and has a purpose; that they do not move in straight lines, but in any curves which may suit their purpose; and that they do not, as two billiard balls do, communicate their rates of motion one to the other by collision. But, making such reservations, some idea may be gained of the encounters of molecules by encounters in a football field.

In considering averages it is clear that there must be a practical limit on both sides of the mean. If a man throws dice he may turn up sixes thrice in succession, or some greater number of times, by chance; but it is clear he will not go on throwing sixes for ever, though there is no absolute reason why he should not. Similarly, in thinking of the rates of motion of molecules there will be a practical limit of rate at which any one molecule will move. It is unlikely that any one molecule will cease to move for any appreciable time; and it is unlikely, too, that any one molecule will develop any exceptionally rapid velocity, say twenty times the mean. Still, such events may conceivably occur; they will, however, be very infrequent.

Those gases which are light, and whose molecules have a high intrinsic average rate of motion, will, in the nature of things, contain some molecules which happen to be moving at a high speed, and necessarily will contain more such than a gas of higher density, the average rate of motion of whose molecules is slower. It may happen that molecules of each kind, of gas with low as well as of gas of high density, may possess such exceptionally high velocity at the confines of our atmosphere, where there are comparatively few gaseous molecules altogether; and it may also happen that these molecules are moving in a direction more or less nearly perpendicular to the surface of the planet, and it may also happen that such molecules suffer no collisions in their vertical path; if these events all happen the molecules will escape. But as, on the doctrine of chances, there are more molecules of light gas endowed with such exceptionally high velocity than there are of heavy gas, more molecules of the former will escape away from the neighborhood of the planet, and enter free space as independent entities, than of the latter.

Such a process, prolonged over ages, will ultimately remove from the atmosphere of a planet all gases possessing less than a certain minimum density.

The next question to which Dr. Stoney addresses himself is: What rate of motion must a molecule have in order that it may escape from the attraction of the earth? The least velocity which will enable such a molecule to escape is about seven miles per second. And it is assumed, from observations taken at high altitudes, that the temperature of the upper regions of the atmosphere is about —66° Cent., or about —87° Fahr.

This velocity of seven miles a second is, however, considerably greater than the average velocity of a molecule of hydrogen, which, at 32° Fahr., it will be remembered, is only about a mile and a quarter. But it is not greater than the velocity of some of the molecules; and these will, therefore, escape. In fact, Dr. Stoney concludes that in every gas a considerable proportion of the molecules have a velocity at least ten times as great as the mean.

Now, on this earth the important constituents of the atmosphere are nitrogen, oxygen. argon, carbon dioxide, water-vapor and ammonia; and their densities are as follows, that of hydrogen being taken as unity:

Nitrogen	14
Oxygen	16
Argon	20
Carbon dioxide	22
Water-gas	9
Ammonia	8.5

We are here chiefly concerned with the gases of the earth's atmosphere, but it may be of interest to cast a glance at other conclusions which follow from Dr. Stoney's speculations.

The moon, the mass of which is much less than that of the earth, would retain a gas of density 40, or thereabouts; but all less dense gases would escape rapidly. From the planet Mercury water-vapor would at once escape, and it is probable that both nitrogen and oxygen would escape more slowly. Argon and carbon dioxide might, however, be permanent constituents of the atmosphere of Mercury. Venus, on the other hand, retains water-vapor; but lighter gases would escape. It must be remembered that if the water were to escape from a planet in the state of vapor its place would be at once supplied by evaporation of planetary seas, if there were any, and that, in the long run, all the water would, in the state of gas or water, leave the planet.

Indeed, Dr. Stoney thinks it not unlikely that we are slowly losing our stock of water. This, however, need excite no alarm, and our water will probably outlast our coal many millions of years. For so few of the molecules of water comply with the required standard of velocity that the rate of loss is almost infinitesimally small.

Similarly, Dr. Stoney conjectures that water cannot remain on Mars; that all known gases would be imprisoned by Jupiter, and that Saturn, Uranus and Neptune may probably be able to retain all gases heavier than hydrogen. As for the sun, its mass is so enormous relatively to that of the planets that, even at the exceedingly high temperature which its atmosphere possesses, it is impossible for any known gas to remove itself from the neighborhood of the luminary.

We must now take leave of Dr. Stoney's fascinating hypotheses for a time, and consider the recent discoveries of gaseous constituents of our atmosphere.

After the discovery of argon as a constituent of air, in 1894, one of the discoverers, acting on advice given him by Professor Miers, was so fortunate as to isolate helium, a gas contained in certain rare minerals, the best known of which bears the name of clèveite. Helium had previously been detected in the chromosphere, the colored at-

mosphere of the sun, by M. Janssen, the well-known French astronomer; and its name was suggested by Messrs. Frankland and Lockyer, in 1868, to characterize the brilliant yellow line by which its presence in the sun is revealed. Neither of these elements has been combined with others, although it is possible that each exists in combination with one or more of the elements contained in the minerals from which helium can be obtained by heating, for it has been found that small quantities of argon, along with considerable quantities of helium, are evolved from such minerals. Again, both of these elements possess one curious property, which they share with gaseous mercury alone, so far as is known, among all elements. That is technically called the ratio between their specific heats at constant pressure and at constant volume. It would be difficult here to set forth the reasoning by which it is deduced that, inasmuch as the ratio for these gases is $1\frac{2}{3}$ to 1 between specific heat at constant pressure and at constant volume, the molecules of these elements, unlike those of oxygen and hydrogen and the other commoner gases, but like those of mercury gas, consist not of agglomerations of two or more atoms, but of single atoms. These characteristics at once establish a connection between the two elements helium and argon, and differentiate them in kind from all other gaseous elements.

Now, taking the density of hydrogen as unity, that of helium is very nearly 2 and that of argon 20. And one of the conclusions which follows from the Kinetic Theory of Gases is that equal volumes of gases contain equal numbers of molecules. Thus the fact that helium is twice as heavy as hydrogen carries with it the conclusion that a molecule of helium is twice as heavy as a molecule of hydrogen, whatever the absolute weight of the latter may be.

Now, it can be demonstrated that there is a strong probability in favor of the assumption that a molecule of hydrogen consists of two atoms, inseparable from each other unless by combination with some other element. And if a molecule of helium consisting of one atom is twice as heavy as a molecule of hydrogen consisting of two, then it follows that an atom of helium is four times as heavy as an atom of hydrogen; in other words, the atomic weight of helium is 4, that of hydrogen being taken as 1. Similar reasoning proves the atomic weight of argon to be 40, from the known fact that it is twenty times as heavy as hydrogen. Moreover, it is noteworthy that the difference between these numbers 40 and 4 is 36.

Mr. John Newlands, whose recent death is deplored by the scientific world, as long ago as 1863 brought forward what he termed a 'law of octaves.' It consisted in arranging the numbers which represent the atomic weights of the elements in seven rows, beginning again with the eighth element, so that its atomic weight occupies a position in the table below that of the first, the ninth below the second, the fifteenth again below the first, and so on. The reproduction of three of such rows will make the meaning clear.

Li	7	Be	9.2	B	11	C	12	N	14	O	16	F	19
Na	23	Mg	24.3	Al	27	Si	28	P	31	S	32	Cl	35.5
K	39	Ca	40	Sc	44	Ti	46	V	52	Cr	52.5	Mn	55
					Etc.		Etc.						

The elements appear in this table in groups, of which the individual members closely resemble each other, often in appearance, and always in the nature of the compounds they form with other elements. Thus, to take the first column, the three elements lithium, sodium and potassium, together with others not here produced, but which occur later on in the table, rubidium and cæsium, are all white waxy metallic solids, easily cut with a knife, tarnishing rapidly in contact with ordinary moist air, and forming compounds which themselves

present the greatest resemblance to one another. Now, in Mr. Newlands' view, the fact that the eighth element resembles the first suggested an analogy with the musical scale, where the tones can be similarly classified, each eighth note of the major scale reproducing, as it were, the fundamental note. In the ordinary notation the name C refers to many notes, separated from each other by octaves. The analogy may be regarded as fanciful, and in the light of more modern work the word 'octave' is here inapplicable; and this perhaps overstrained analogy did much to discredit Mr. Newlands' views in the eyes of the leading chemists of the day. It was not until 1868, when the late Professor Lothar Meyer and Professor Mendeléef independently arrived at a similar arrangement, that the attention of chemists was recalled to the subject and the justice of Mr. Newlands' ideas was acknowledged. The somewhat tardy award of a medal by the Royal Society placed in its true position the work of Mr. Newlands, and was regarded as an act of justice by his friends. It is deeply to be regretted that his recent death has removed from our midst a man so kindly and so alive to every advance in science.

The elements helium and argon, if they be really elements and not compounds (and there is no reason to doubt their elementary nature), should find places in this table, now known as the 'Periodic Arrangement of the Elements.' And confining our attention to only a few of the vertical columns, their position should be for helium before lithium, and for argon before potassium, thus:

Hydrogen	1	Helium	4	Lithium	7
Fluorine	19	?		Sodium	23
Chlorine	35.5	Argon	40	Potassium	39
Manganese	55	Iron Cobalt Nickel	56 58 59	Copper	63.5
Bromine	80	?		Rubidium	85

Now, we find the difference between the atomic weights of hydrogen and chlorine to be 34.5; and between lithium and potassium to be 32; also between argon and helium to be 36. These numbers are roughly of the same order of magnitude. It is, therefore, not unreasonable to suspect the existence of an undiscovered element with atomic weight between 19 and 23, as well as of others occupying the other unfilled positions in the argon group.

It is no easy matter to hunt the earth through for an unknown element. The question is, where to look. And some clue is necessary to guide the inquiry. At first it was thought that minerals similar to those from which helium had been obtained might possibly yield the new element; and experiments were made, for months at a time, to test the gases obtainable from almost every known mineral, but in vain, so far as a new element was concerned. They resulted in the discovery of many new sources of helium; but the spectrum of the gas in each case exhibited no unknown lines A new method of attack was then organized. It might be that the so-called helium was really a mixture of elements, and not a pure element. Now, an effective method of separating from each other two gases of different molecular weights, and hence of different densities, is the process of diffusion. From observations of the late Professor Graham, of University College, London, subsequently Master of the Mint, it appears that lighter gases, with rapidly moving molecules, will pass through a porous diaphragm, such as the material of a clay pipe, more rapidly than a heavier gas, with its more slowly moving molecules. An attempt was, therefore, made to ascertain whether any heavier gas could be thus separated from the helium obtained from minerals; the experiments involved an enormous amount of labor, but, in the end, no gas other than a trace of argon could be

detected. It appeared, therefore, vain to attempt to discover a new gas in minerals; and the justice of Dr. Stoney's hypothesis was next tested. It was, of course, not out of the question that the sought-for gas might exhibit some powers of combination, and that it might have been absorbed, along with the nitrogen of the air, by the magnesium over which the gas had been sent at a red heat in order to absorb and remove the nitrogen. The compound of magnesium with nitrogen is very readily decomposed by water; the products are ammonia and hydroxide of magnesium. A large quantity of this magnesium nitride was accordingly treated with water, and the resulting ammonia absorbed by means of weak sulphuric acid. There was merely a trace of gas which refused to be absorbed, and, on examination, it turned out to be the familiar hydrogen, which was formed by the action of the water on some metallic magnesium which had escaped combination with nitrogen. This experiment was interesting, inasmuch as it proved that magnesium refuses to combine with even the smallest trace of argon. The ammonia resulting from this treatment, it is true, might have conceivably contained a compound of the new gas; but a similar sample had previously been decomposed, so as to obtain from it its nitrogen, and that sample of nitrogen had been found by Lord Rayleigh to possess the same density as a sample of nitrogen of which the source could not be traced to the atmosphere. Lastly, it was conceivable that the hydroxide of magnesium might have contained some compound of the new element. It was, therefore, treated with water, and the soluble portion separated from the insoluble. The soluble portion, on examination, proved to contain nothing but the carbonate of magnesium. The insoluble portion was not further dealt with, but was kept in reserve.

The argon of the atmosphere was next examined. A large quantity having been prepared, it was purified, and by passing it into a vessel immersed in liquid air, made to boil at an even lower temperature than usual by pumping away the air-gases as they boiled off; the argon, too, was completely changed into liquid. Liquid argon is clear and colorless, whereas liquid air has a faint blue tint, owing to the blue color of the oxygen it contains. The argon was next made to boil, by allowing the temperature of the liquid air to rise a few degrees, and the first portions of argon-gas were collected separately, the remainder going back into the gas-holder in which it had originally been stored. The gas thus obtained was lighter than argon, and more difficult to liquefy; this was shown by the necessity of compressing it into the bulb in which liquefaction took place. The most volatile portions of this liquid were next collected separately, and the gas proved to be still less dense than the former sample. It was not possible to liquefy more than a small fraction of this last specimen of gas, to however low a point the temperature of the boiling air was reduced; and after another repetition of the same process the gas appeared to be as light as the process could make it. Its density was 9.75 times that of hydrogen, and, making allowance for a small quantity of argon which it must necessarily have contained, this number becomes reduced to 9.6.* The weight of a molecule, compared with the weight of an atom of hydrogen, as previously explained, must therefore be 19.2; and 19.2 lies between the atomic weights of fluorine, 19, and of sodium, 23, falling therefore into the predicted place in the Periodic Table. The specific heat ratio of this new gas, to which

* This gas has since been found to contain a trace of helium, the presence of which would lower the above density. The actual density will, therefore, be somewhat higher than 9.6, but it will probably not exceed 10. It has not yet been determined.

the name 'neon,' or 'the new one,' has been given, is, as in the cases of helium and argon, $1\frac{2}{3}$; like them, too, it resists combination with other elements, and possesses a brilliant and characteristic spectrum.

This account of the fulfilment of a prediction has, I am afraid, been somewhat elaborate for the general reader; but it is interesting as a case of discovery, where many lines of evidence, founded on the work of many different observers, have led to the foreseen conclusion. It possesses, to my mind at least, some of the qualities of a scientific poem—an orderly arrangement of ideas, drawn from many different sources, each throwing light on the other, and all tending towards a final event. It is true that the subject is not one to which poetical diction can be applied with advantage; the details are too complicated, too unfamiliar, and to be expressed only in language which has not received the impress of poetical tradition; but to enlarge on this would open a wide field of discussion, in which æsthetics, a subject not as yet reduced to accurate formulation, and perhaps hardly susceptible of treatment by scientific methods, would form the chief theme.

In epic poems the 'argument' usually precedes the matter. Here it may be convenient to reverse the order and to sum up the preceding pages by the argument. We have seen, then, that the discovery, by Lord Rayleigh, of a discrepancy in the density of atmospheric nitrogen has resulted in the discovery of a new constituent of air—argon; its discovery has led to that of a constituent of the solar atmosphere, helium; speculations on the ultimate nature and motion of the particles of which it is believed that gases consist has provoked the consideration of the conditions necessary in order that planets and satellites may retain an atmosphere, and of the nature of that atmosphere; the necessary existence of an undiscovered element was foreseen, owing to the usual regularity in the distribution of the atomic weights of elements not being attained in the case of helium and argon; and the source of neon was, therefore, indicated. This source, atmospheric air, was investigated, and the missing element was discovered. A new fact has been added to science, and one not disconnected from others, but one resulting from the convergance of many speculations, observations and theories, brought to bear on one another.

William Ramsay.

ON SOME ANALOGIES BETWEEN THE PHYSIOLOGICAL EFFECTS OF LACK OF OXYGEN, HIGH TEMPERATURE AND CERTAIN POISONS.

One of the striking characteristics of vital phenomena, from a chemical standpoint, is the comparatively low temperature at which oxidations take place. Among the more commonly accepted theories which try to account for this fact is that of Hoppe-Seyler. Hoppe-Seyler found that in case of putrefaction reducing substances, such as nascent hydrogen, are formed. These reducing substances, if atmospheric oxygen is present, attack the molecule of oxygen, taking one atom to themselves and setting free one atom. This free atom of oxygen, being in an active state, is able to bring about the oxidations characteristic of living organisms.

According to Hoppe-Seyler's theory similar fermentations take place in all living matter whereby reducing substances are formed. In case of lack of oxygen it is clear that, while fermentation may go on, the oxidation of the reducing substances comes to a standstill. In this case the reducing substances may attack other substances in the animal body, instead of oxygen, and form compounds which may act as poisons.

It is a well-known fact that an increase

of temperature up to a certain limit increases fermentation. Suppose the temperature of a cold-blooded animal be raised to 35 or 40°C. Fermentation will be enormously increased; in fact, it may become so great that all the reducing substances formed are not able to find sufficient oxygen for oxidation. Hence, the same condition may obtain as in lack of oxygen. To show this similarity of death by lack of oxygen and heat, we made, at the suggestion of Dr. Loeb, the following experiments upon the protozoan, *Paramecium Aurelia*. A great number of these little organisms were placed in small glass dishes and either subjected to a temperature of 35–40° or to lack of oxygen. First, a lot of *Paramecia* were placed in distilled water and the length of time necessary to kill them by lack of oxygen was noted. Next, two more lots were placed in a weak solution of alkali (NaOH) or acid (HCl). It was found that, compared with pure water, acids in concentration even as low as 1/876% decreased the time necessary to kill *Paramecia* by lack of oxygen; while alkalies of even 1/800% increased the time by 75–175%.

What has been said concerning lack of oxygen and the effects of acid and alkali may be repeated for high temperature. Acid decreases the time needed to destroy *Paramecia* by high temperature. Sodium hydrate, on the other hand, increases the time as much as from 20 to 80%. The similarity in these two cases, *i. e.*, lack of oxygen and high temperature, is, therefore, very striking.

How can we explain these facts? Why is it that alkali increases the resistance power of Paramecia against heat and lack of oxygen?

We stated that in case of lack of oxygen fermentation goes on, but that the oxidation of the reducing substances is diminished and finally stopped, and that these reducing substances may act destructively upon the organism. Now we may suppose that alkalies act either upon the reducing substances themselves or upon the injurious substances formed by them so as to render them inert.

The same course of reasoning applies in regard to the behavior of alkali in case of high temperature.

To prove this we have still another test. Claude Bernard and Geppert have found that in an animal poisoned by potassium cyanide the blood remains arterial and the tissues have lost the power to take up oxygen. In other words, such an animal really dies because of lack of oxygen. If, then, our theory is correct that alkali is beneficial in lack of oxygen we might also expect alkali to prolong the life of Paramecia poisoned by potassium cyanide. In order to prove this we made the following experiments.

One drop of 1% KNC solution was placed in a dish containing 10 drops of water and one drop of culture containing Paramecia was added. The length of time taken to destroy all the animals was noted. The same experiment was repeated, but instead of water a weak solution of sodium hydrate (1/200–1/2000%) or of acid was used. In all cases the acid shortened the time; salt solutions (1/200–1/2000%) had no effect; alkali increased the length of time from 50 to 300%.

The same results were obtained in case of poisoning by atropin. When it is remembered that solutions of KNC and atropin are alkaline in reaction, it is evident that the beneficial effect of sodium hydrate is not due to its antagonizing these poisons directly.

This is still better seen in the experiments with Sulphate of Strychnia. As the strychnia solution employed had a decidedly acid reaction, *a priori*, we should expect that here alkali would show its beneficial action

most signally. Yet both acid and alkali decrease the power of resistance of Paramecia against this poison. Neither has alkali a favorable action in case of poisoning by veratrin, although this, like KNC and atropin, has an alkaline reaction.

We thus see that our theory also stands this test successfully. As alkalies and not acids have this property, it seems possible that the destructive substances formed by fermentation are acids. Whatever may be the real explanation, the fact remains true that Paramecia are able to endure lack of oxygen, high temperature and the action of poisons like KNC and atropin for a longer time in weak alkali solutions than in neutral or acid solutions.

William Zoethout.

Hull Physiological Laboratory,
University of Chicago.

LEIDY'S GENUS OURAMŒBA.

HISTORY.

At a meeting of the Dublin Microscopical Club, February 15, 1866, Mr. William Archer exhibited specimens of *Amœba villosa* (Wallich), calling special attention to the presence of "a large and numerous tuft of very long prolongations issuing from just behind the villous patch. * * * He thought it could readily be seen that these curious fasciculi were not composed of foreign bodies either issuing from or penetrating into the *Amœba*, but were really linear prolongations of the sarcode itself. * * * This observation, *quantum valeat*, seems possibly to point to a still greater differentiation of parts than has yet been observed in this remarkable form."*

After nearly eight years, October 23, 1873, Mr. Archer again drew the attention of the Dublin Microscopical Club to the same condition in *Amœba*. He still considered the projections from the posterior end to be prolongations of the body substance, though the behavior (as regards flow of contents, locomotion, etc.) was quite that of an *Amœba villosa*.*

In May of the year following, Dr. Joseph Leidy, of the University of Pennsylvania, found in the vicinity of Philadelphia a singular amœboid creature carrying tufts of caudal filaments, and gave a brief description of it in the *Proceedings of the Academy of Natural Sciences of Philadelphia*, bestowing upon it the name *Ouramœba*, in allusion to its tail-like filaments, and distinguishing several forms.† An abstract of this paper published in the *Monthly Mic. Journal*, November, 1874, brought from Mr. Archer the citation of his original notice of 1866, both observers reaching the conclusion that they had lighted upon the same creature.‡ An illustrated notice of the form by Dr. Leidy appeared in the Philadelphia *Proceedings* of 1875.§ In 1879 the *Fresh-water Rhizopods of North America* was issued under the auspices of the U. S. Geological Survey. Dr. Leidy's final treatment of *Ouramœba* occurs in that sumptuous volume. The points which bear directly upon the thesis of the present paper may be briefly summarized:

1. The caudal filamentous appendages alone excepted, Leidy remarked no difference between *Ouramœba* and *A. proteus;* while Mr. Archer regarded the form observed by him as identical with *A. villosa*, the filaments excepted.‖

2. "The mode of fixation of the caudal filaments is difficult to comprehend. In a detached tuft the root appeared to be continuous with a ball of homogeneous protoplasm."¶

Quart. Journ. Micr. Soc., 6:190.

*Idem, 14:212.

† Proceed. Acad. Nat. Sci. Phila., 1874, p. 78.

‡ In 1874 Mr. Archer doubted the validity of the proposed genus *Ouramœba*, although he thought the filaments retractile. See *Quart. Jour. Mic. Soc.*, 15: 203; but compare Idem, 16: 337.

§ Idem, 1875, p. 126 *f.*

‖ Fresh-Water Rhiz. N. Amer., p. 68.

¶ Idem, p. 69.

3. "In the movements of *Ouramœba* the caudal filaments were entirely passive."*

4. "When first seen I regarded the animal as an *Amœba proteus* dragging after it a bundle of mycelial threads [accidentally attached to it?]. * * * I came to the conclusion that the threads were parts of its structure. * * * The caudal filaments present so much resemblance to the mycelial threads of fungi that I have suspected they may be of this nature, and parasitic in character, due to the germination of spores which had been swallowed as food. * * * There is, however, perhaps an important objection to this view, and that is, the caudal filaments do not grow from a mycelium within the protoplasmic mass of the body of the animal. According to Mr. Archer, *Ouramœba* * * * may be only a varietal form of what I have considered to be *Amœba proteus*, but the solution of the question remains for future investigation."†

The next published allusion to this problematic creature was in 1885.‡ Dr. Gruber, in the description of his species *Amœba binucleata*, speaks of fungus filaments lying within the body, but which, in a chromic-acid preparation, issued in tufts and in some places covered the exterior. Confessing that he cannot explain this singular effect of the acid, he suggests that the coming-out of such fungus threads in the living animal might produce appearances like those figured by Leidy, and that the strange attachments to Leidy's *Ouramœba* are nothing but such fungi.

My own study of it began February 6, 1894. The specimen was taken three days before at Wake Forest, in a small stream but a few yards out of a spring. The current was checked by a luxuriant growth of a pond-weed here and there, so that a large brown *Oscillaria*, which abounded in the collection, had no trouble to keep its footing and thrive. This first specimen I had under observation from the 6th of February to the 22d of March, though after the first six days it was in the encysted condition represented in Fig. 7. At no other season of the year than February and March and in no other locality have I met with specimens.

EXPLANATION OF PLATE.

Fig. 1. Filament of *Ouramœba* branched near peripheral end. *Free-hand.*

Fig. 2. Another mode of branching. *Free-hand.*

Fig. 3. Detached filament, sketched free-hand as it lay free in the water a few minutes after its separation.

Fig. 4. Cluster of detached filaments. *Free-hand.*

Fig. 5. A filament of a detached and somewhat disintegrated mass, showing connection with the spore.

Fig. 6. A cluster of filaments springing from included spore whose wall is plainly distinguishable. *Somewhat diagrammatic.*

Fig. 7. Encysted *Ouramœba: a*, filament still attached to the protoplasm, which is contracted from cyst-wall; *b*, shed filament in mass of débris, *c*, attached to cyst. *Cam. luc.* × *95.*

Figs. 8–10. The same cluster of filaments in three successive stages of development, the stage in Fig. 9 being one day older than that of Fig. 8, and Fig. 10 two days later than Fig. 9. *a* and *b* are the original branches of the germ-tube; *a'*, *a''*, primary and secondary branches of *a; b'* and *b''*, primary and secondary branches of *b; c. v.*, contractile vacuole. *After tracings of Mr. Martin F. Woodward's camera lucida drawings.* × *800.*

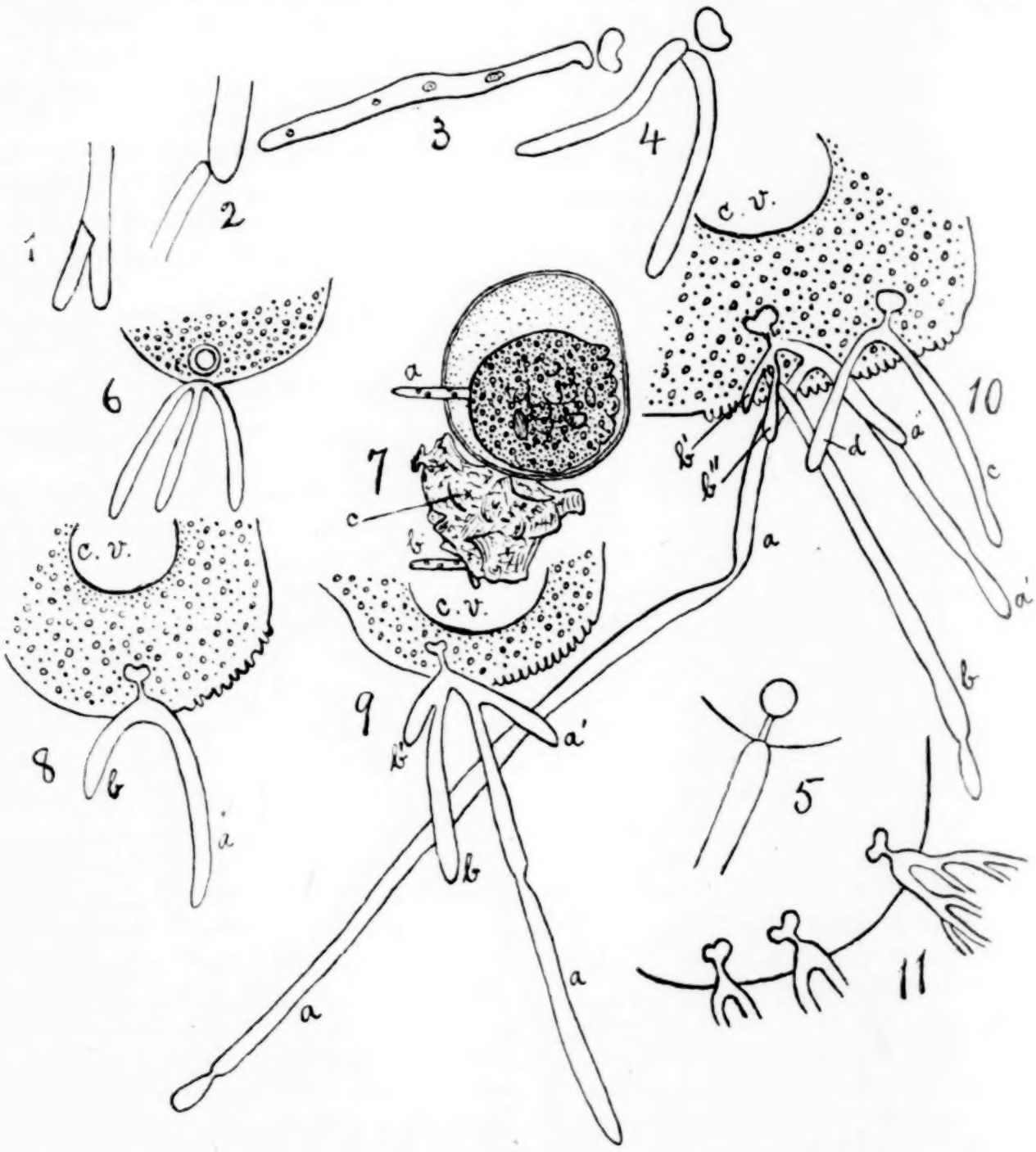
Fig. 11. Portion of a large specimen, showing attachment of three clusters of filaments. *After Mr. Martin F. Woodward.* × *800.*

* Fresh-Water Rhiz. N. Amer., p. 69.

† Idem, p. 69–70.

‡ Gruber, Zeitschrift f. Wissenschaft. Zool., 41:210, 211.

In a note published in *Nature* for May 24, 1894 (Vol. 50, p. 79), I announced the conviction that the filaments are a parasitic fungus growing upon the genus *Amœba*. Early in 1896 Mr. Martin F. Woodward, of the Royal College of Science, London, wrote me that he entertained the same view. Later, with signal generosity, he forwarded to me notes of his own observations with tracings of his original drawings. I wish to make the fullest recognition of this courtesy, with sincere acknowledgment of my obligations to him. I am indebted, furthermore, to Mr. Irving Hardesty, of the University of Chicago, and Dr. C. L. Felt, of Philadelphia, for assistance upon the literature of the form.



THESIS.

Leidy's genus *Ouramœba* was erected upon insufficient data and must be abandoned.

The filamentous appendages, which constitute the only peculiarity of the form, are not, as he and Archer supposed, extensions of the body-substance; they are, on the contrary, mycelial hyphæ, commonly unseptate, which spring from a spore lying in the endosarc, and which stand in a semi-parasitic relation to the genus *Amœba*.

The facts which I submit in support of this thesis are both morphological and physiological.

1. *Morphological.*—It may be remarked at once that Dr. Leidy's text description and plate delineations represent, with life-like precision, the general features of the structure, and make it unnecessary to set forth forth here what has already been done so admirably. I mention only what he omitted to notice or failed to see the exact significance of.

a. The single or tufted filaments arise invariably from a spore. See Figs. 3, 4, 5, 6, 10. In Dr. Leidy's Plate IX., Fig. 11, there is a suggestion of this structure, but the text reference to it shows that he did not recognize the spore.* In the specimens which I studied it was usually conspicuous, though the structural continuity of spore and filament could not always be made out, even when the filaments were detached. Cf. Figs. 3, 4 and 6. In this case, however, the spore came away with the filaments.

This would seem to be decisive of the fungoid nature of the filaments. Leidy's already quoted objection, viz., that the filaments do not grow from a mycelium within the body of the animal, becomes groundless when it is seen that the filaments are themselves the branched mycelium resulting from the germination of the spore. The fact that the mycelium, instead of ramifying through the protoplasmic mass, issues at once into the water, suggests that this fungus does not subsist at the expense of the *Amœba*, but upon organic substances dissolved in the water. Some of these are doubtless contributed by the contractile vacuole, which, as I observed, always lies in the neighborhood of the filaments; in at least one case I saw it discharge its contents among them. If this be true, we may accordingly mention two advantages which the fungus secures by its association with the *Amœba*: first, a food-supply in the wastes of the *Amœba*; second, change of location with consequent improvement of 'pasturage.'* And so I have spoken of the dependence as semi-parasitic.

b. The structure of the filaments is that of unseptate hyphæ, not that of pseudopods. An occasional septum at the origin of a branch makes the pseudopod interpretation impossible. It must be said, however, that the characteristic mode of branching is peculiar among the fungi.

c. After separation from the *Amœba* the filaments maintain in all respects their specific structure and relations. In some cases I saw tufts of filaments, each with its spore, come away from the host, for no apparent reason, as it moved through the water. At other times, by pressure upon the cover-glass, the filaments were forcibly separated. In all cases the filaments were unaffected by the change, and the *Amœba* showed no sign of his loss in either his structure or his movements.

2. We may attend now to certain *physiological* facts bearing upon the thesis of this paper.

a. As noted above, the form on which these fascicled hyphæ were found by Mr. Archer in Ireland was *Amœba villosa*. Mr. Woodward informs me that the same is true of his specimens, found, I presume, in the neighborhood of London. If I have correctly interpreted Dr. Gruber, he found

*Fresh-Water Rhizopods, p. 68. Cf. Proceed. Acad. Nat. Sci. Phila., 1874, p. 78.

*Gruber (loc. cit.) suggests the advantage of oxygen supply from ingested algæ.

these structures on his species *A. binucleata* in Germany. But the host form in this country, according to Leidy's observations and my own, is *A. proteus*. As Mr. Woodward suggests, this fact of itself creates a presumption of the fungoid nature of the filaments.

b. The occurrence of the form at a limited season of the year is in keeping with the plant nature of the filaments. While one of the specimens of Mr. Archer appears to be an exception, all the others were found, I infer, in the early part of the year, from January to May. My own were taken in February or March of three successive years. The same locality was searched for them at other seasons in vain, though uninfested *Amœbæ* were found.

c. The hyphæ take no part in the movements of *Amœba*. If they bend or diverge, such movements are entirely passive, being due to contractions of the protoplasm to which their bases are attached. This is the explanation of what Archer interpreted as the creature's power of bending and quickly again erecting the filament at the point of constriction.* All observers agree that they are non-retractile. Cf. Fig. 7, *a* and *b*.

d. The progressive development of a single tuft is sufficient of itself to establish the main point of the thesis. It is clearly indicated in Figs. 8, 9 and 10, which are three of a series of five drawings representing as many stages of development of the same cluster. The fourth and fifth are not shown. Mr. Woodward tells me that after the first week the cluster of filaments became too complicated in its branching to draw, "although they always retained their original character of springing from a basal U-shaped filament and not branching near the distal extremities." Furthermore, Mr. Woodward observed on the same slide with this large specimen a number of small ones which "only after a week were found to possess any filaments."

* *Quar. Journ. Micr. Soc.:* 6, 190.

* * * * *

An interesting inquiry remains to be made into the life history and relationships of the fungus itself, but upon that inquiry I cannot enter now.

Wm. L. Poteat.
Wake Forest College, N. C.

NEW NAMES FOR SPERMOPHILUS BREVICAUDUS, CANIS PALLIDUS AND SOREX CAUDATUS MERRIAM.

Three names given by me to new species of mammals prove to be preoccupied and are here replaced.

Spermophilus chrysodeirus brevicaudus Merriam (Proc. Biol. Soc. Wash. VIII., 134, December 28, 1893), from the San Bernardino Mountains in California, is preoccupied by *Spermophilus brevicauda* Brandt (Bull. Acad. St. Petersburg, 1844, II., 369) from the southern Altai. I propose in its stead *Spermophilus* (*Callospermophilus*) *bernardinus*.

Canis pallidus Merriam (Proc. Biol. Soc., Wash., XI., 24, March 15, 1897), from the plains of Nebraska, is preoccupied by *Canis pallidus* Rüppell (Atlas zu Reise in Nördl. Afrika I., 33, taf. 11, 1826) from Kordofan. I propose in its stead *Canis nebracensis*.

Sorex saussurei caudatus Merriam (N. Am. Fauna, No. 10, p. 84, Dec. 31, 1895), from Reyes, Oaxaca, Mexico, is preoccupied by *Sorex caudatus* Hodgson (Horsefield's Catal. Mammals Mus. East India Co., p. 135, 1851), from Sikkim and Darjeling, India. I propose to replace it by *Sorex saussurei mutabilis*.

C. Hart Merriam.

A NEW NAME FOR MICROTUS INSULARIS BAILEY.

In a preliminary paper describing several new Voles (Proc. Biol. Soc. Wash., XII., 86, April 30, 1898) I gave the name *Microtus insularis* to a species from Great Gull Island, N. Y. This name proves to be pre-

occupied by *Lemmus insularis* Nillson (= *Microtus agrestis* L.), described in the Œfversigt K. Vetensk, Akad. Förhandlingar, Stockholm, I., 33–35, 1844. I therefore propose the name *nesophilus* in place of *insularis* for the Great Gull Island *Microtus*.

VERNON BAILEY.

CHANGE OF NAME FOR SCIURUS ALBIPES QUERCINUS NELSON.

THE name *Sciurus quercinus* which I used for a Mexican squirrel recently described as *S. albipes quercinus* (Proc. Biol. Soc. Wash., June 3, 1898, XII., pp. 150–151), proves to be preoccupied by Erxleben (Syst. Reg. Anim. 1777, p. 432). I therefore propose for the Mexican subspecies the name *hernandezi*.

E. W. NELSON.

NOVEMBER 19, 1898.

PROFESSOR JAMES INGRAHAM PECK.

BY the death of James Ingraham Peck, Williams College loses an able and beloved professor; the Marine Biological Laboratory, an executive officer of rare ability; American Biology, an investigator of keen perception; and a host of young biological workers, a willing helper and an inspiring friend.

Dr. Peck was born at Seneca Castle, Oneida county, New York, August 10, 1863, and entered Williams College from Canandaigua Academy when twenty years of age. After the completion of his college course he remained for one year as a graduate student, and took a second year of graduate work at Johns Hopkins University. In 1892 he was appointed assistant in biology at Williams College, and in 1894 he was promoted to the position of assistant professor, which office he held until the time of his death, November 4, 1898. He leaves a wife, a woman universally beloved, and a little boy.

Although Dr. Peck was a thorough teacher and a man of unusual popularity both with students and officers, it was not through his academic work at Williamstown, but rather through his scientific and executive work at Woods Holl, that he was best known.

In 1888 Dr. Peck prepared one of the first serious contributions to the study of Variation that had been made since the time of Darwin. The summer of 1889 he spent at Woods Holl, where he worked upon the habits of the young of certain food fishes. In 1890 he published his Cymbuliopsis paper. In 1892 he was again a member of the scientific staff of the Fish Commission Laboratory, where he worked upon the Pteropods and Heteropods collected by the Albatross. The summer of 1893 was spent in preparing his paper on the 'Food of the Menhaden,' and in 1894 he continued his plankton studies and prepared a paper on the 'Sources of Marine Food.' In 1895 he was placed in charge of the Laboratory of the Fish Commission, and in 1896 he accepted the position of Assistant Director of the Marine Biological Laboratory.

For the three years that Dr. Peck was in charge of the general affairs of the Marine Biological Laboratory he worked with untiring energy, and inspired all who visited the Laboratory with a spirit of devotion to science and of loyalty to the institution. During the past summer he worked with unabated energy, denied himself the many opportunities for rest and recuperation that his students and friends besought him to take, and returned to Williamstown entirely unfitted to withstand the strain of severe illness. He literally sacrificed himself for science.

H. C. BUMPUS.

BROWN UNIVERSITY, PROVIDENCE, R. I.

NOTES ON INORGANIC CHEMISTRY.

THE leading article in the last number of the *Chemical News*, is a long criticism of the recent, supposed discovery of a new gas,

etherion, by Charles F. Brush, from the pen of the editor, Sir William Crookes. From his long continued familiarity with work at low pressures, especially in connection with work on radiant energy, and on the so-called meta-elements, it is hardly an exaggeration to say that there is no more competent critic of Brush's work than Professor Crookes. He has repeated some of Brush's experiments and is inclined to attribute the peculiar phenomena obtained to the presence of a trace of aqueous vapor. This seems the more probable, in view of the fact that Brush found that the etherion seemed to be absorbed by phosphorus pentoxid and by soda-lime. Having only seen the abstract of Professor Brush's paper, Professor Crookes does not assume to speak authoritatively in the matter, but only of the probabilities. In their modest, unassuming tone, the papers of both these distinguished scientists might well serve as models.

In an article on the reactions of acetylene in the *Zeitschrift für anorganische Chemie*, Hugo Erdmann and Paul Köthner call attention to the possibility of utilizing acetylene for the production of aldehyde. The thought of the commercial synthetic production of similar substances is not new. Several years ago Krüger and Pückert proposed the manufacture of alcohol by precipitating acetylene with corrosive sublimate,treatment with hydrochloric acid and reduction of the aldehyde formed; indeed, nearly half a century ago the manufacture of 'mineral spirits' was exploited. Apparently these processes would all be too expensive for the production of alcohol, while the continuous process of Erdmann and Köthner might be a commercial possibility for making the more valuable aldehyde. This process consists in leading acetylene through a boiling mixture of 44% sulfuric acid in the presence of mercuric oxid. The aldehyde distills off and the unused acetylene is recovered. The presence of phosphoric acid seems to give a purer product. In a quantitative experiment from 125 grams calcium carbid of 95%, there were obtained 80 cc. of 5% aldehyde. It is not at all improbable that the cheap production of acetylene from calcium carbid may render possible, in the near future, many syntheses of organic products on a commercial scale.

The verification of inorganic data of past years has received a valuable contribution from A. Ladenburg, in the *Berichte*, in the redetermination of the density of ozone. Soret's classic researches of thirty years ago on ozone were with a mixture containing only 5 per cent. ozone and hence not beyond criticism. In Ladenburg's method an 8 to 9 per cent. mixture of ozone and oxygen was directly obtained by usual methods and this mixture condensed to a liquid by means of liquid air. On boiling the mixture much of the oxygen could be driven off, and by repeating the process several times a liquid mixture was obtained containing 86 per cent. ozone. For determination of density Bunsen's 'Ausströmungszeit' method was used. The density found for pure ozone relative to that of oxygen was 1.456, which is very close to the theoretical value 1.5, and the generally received composition of ozone, O_3, is confirmed. In this investigation it was incidentally found that liquid ozone is very dark blue and in layers two or three centimeters thick completely opaque; that it is almost insoluble in water, but 0.00002 part by weight and 0.01 part by volume being dissolved in one of water. In determining the boiling point a mixture of ozone and oxygen boiled at $-186°$ until apparently only ozone was left. The thermometer then rose to $-125°$ when the liquid ozone appeared to begin boiling. At this moment a very violent explosion occurred, the whole apparatus being shattered. It would appear from this that the boiling

point of ozone cannot be below —125°. According to Troost it is —119°, while earlier, Olszewsky had placed it at —106°.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

AUGUST HOT WAVE IN CALIFORNIA.

THE August number of the California Section of the Climate and Crop Service contains an account of the hot wave of that month, by George H. Wilson. This hot wave lasted one week, and was the most severe on record, throughout the Sacramento and portions of the San Joaquin Valleys. Maxima up to 120° were noted, and the temperatures were about 20° above the normal in the great valleys on August 11th. In the Sacramento Valley it is stated that birds flew into the houses, seeking shelter from the withering heat, and in a few cases they are reported to have fallen dead from the trees. During the hot wave there was a marked absence of northerly winds in the interior valleys, and as the ground was very dry, owing to a drought, the surface was effectively heated.

MONTHLY WEATHER REVIEW.

THE August number of the *Monthly Weather Review* is one of unusual interest. Among the papers it contains are the following: 'The Effect of Approaching Storms upon Song Birds,' by C. E. Linney; 'Progress in the Exploration of the Air with Kites at the Blue Hill Observatory,' by A. Lawrence Rotch; 'Destruction by Lightning in New York State during the month of August, 1898,' by R. G. Allen; 'The Measurement of the Wind,' 'Sensible Temperatures or the Curve of Comfort,' and 'Waterspouts on the Lakes,' by Professor Cleveland Abbe.

NOTES.

THE Southern Pacific Railroad Company has recently supplied ordinary meteorological instruments to 181 of its stations between Ashland, Ore.; Ogden, Utah, and El Paso, Texas. The state of the weather, direction of wind, temperature and rainfall are included in the daily record, and at nine important points pressure readings are made. Daily telegraphic reports are forwarded from each point to San Francisco. Weekly crop reports are also sent from 52 important producing centers. The Company forwards over its own wires, without charge to the government, warnings of frosts and hot northers. The meteorological observations thus collected are placed at the disposal of the Weather Bureau.

IN the September number of the *Monthly Review* of the Iowa Weather and Crop Service it it noted that of 266 head of live stock killed in Iowa by lightning during the past summer 118 were found in close contact with wire fences.

R. DE C. WARD.

HARVARD UNIVERSITY.

BOTANICAL NOTES.

SOME MORE ATROCIOUS BOTANY.

IT is quite bad enough that we have textbooks on elementary botany that are so full of error that teachers have to be warned not to use them, but now we find a new source of confusion and erroneous infection in an unexpected quarter. Our attention has just been called to a recent book, 'Applied Physiology,' by Dr. Overton, published by the American Book Company, in which the author manages to bring in more than the usual number of misrepresentations and misleading statements regarding plants, commonly found in such books. The following examples will give an idea of the botanical pabulum which the Doctor supplies to his pupils:

"The greater part of all young plants is starch" (p. 26). "Each grain [of starch] is made up of layers of pure starch separated by an exceedingly thin layer of a substance like cotton, called cellulose" (p. 26). "As

a plant grows, the starch is changed into wood" (p. 26). "When yeast germs are added to bread dough they grow rapidly and produce alcohol and carbonic acid gas out of sugar, which is always found in flour" (p. 43). "Mold is a common plant which lives upon albumin. It can grow upon the coarsest kinds, as upon wood or leather, as well as upon the best, as meat or cheese. It consists of tiny rods scarcely $\frac{1}{1000}$ of an inch in length, joined end to end" (p. 383). "Bacteria produce decay." * * * * "All decaying matter is intensely poisonous from the presence of these toxins" (p. 384). "*Mold*, a microscopic plant whose filaments in their growth burrow through substances. At intervals they send up seed-stalks which form a velvet-like covering" (Glossary, p. 415). "*Nucleus*, a darker mass in the midst of a cell" (Glossary, p. 416). "*Spore*, the germ cell of a flowerless plant" (Glossary, p. 421). See "*Germs*, a common name for bacteria of disease" (p. 411). "*Starch*, a food substance composed of carbon hydrogen and oxygen in the same proportions as in sugar" (Glossary, p. 421). "*Sugar*, a sweet substance composed of carbon, hydrogen and oxygen in the same proportions as in starch" (Glossary, p. 421).

There can be no valid excuse for the publication of such stuff as the foregoing. No publishing house should allow a manuscript to go to press until it has satisfied itself that the book is reasonably free from errors, not only in the principal subject treated, but in those subjects which receive secondary consideration.

WESTERN WEEDS.

A recent bulletin from the Idaho Experiment Station is devoted to a discussion of 'Twelve of Idaho's Worst Weeds.' It includes: 1, Wild Oats (*Avena fatua*); 2, Prickly Lettuce (*Lactuca scariola*); 3, Russian Thistle (*Salsola kali tragus*); 4, Tumbling Mustard (*Sisymbrium altissimum*); 5, Cockle (*Saponaria vaccaria*); 6, Canada Thistle (*Carduus arvensis*); 7, Alfalfa Dodder (*Cuscuta* sp.); 8, False Flax (*Camelina sativa*); 9, Sunflower (*Helianthus annuus*); 10, Squirrel-tail Grass (*Hordeum jubatum*); 11, Common Tumble Weed (*Amaranthus albus*), and 12, Horehound (*Marrubium vulgare*). To an Eastern farmer this list will appear quite strange, as with but two or three exceptions the plants, which are among the *worst* weeds in Idaho, are of little importance as weeds in the East.

A similar list made by the writer four years ago for eastern Nebraska is, perhaps, still more striking. These are the weeds of the fields and pastures approximately in the order of their harmfulness, beginning with the worst: 1. Russian Thistle (*Salsola kali tragus*); 2. Sand-bur (*Cenchrus tribuloides*); 3. Milk-weed (*Asclepias syriaca*); 4. Buffalo-bur (*Solanum rostratum*); 5. Sunflower (*Helianthus annuus*); 6. Horseweed (*Erigeron canadensis*); 7. Big Ragweed (*Ambrosia trifida*); 8. Bitterweed (*Ambrosia artemisiæfolia*); 9. Squirrel-tail Grass (*Hordeum jubatum*); 10. Cockle-bur (*Xanthium canadense*); 11. Porcupine Grass (*Stipa spartea*); 12. Purslane (*Portulaca oleracea*). In this list, again, the Eastern farmer will note the absence of most of the weeds which trouble his fields. On the other hand, he has had no experience with 1, 2, 4, 5, 9 and 11, as weeds.

ECONOMIC GRASSES OF THE UNITED STATES.

Professor Scribner, of the Division of Agrostology, of the United States Department of Agriculture, has just issued a valuable bulletin (No. 14) describing the grasses which are used for forage, ornamental and other purposes. No less than 252 species are included, many of which are introduced from other countries, while many, perhaps most, are natives of this country. Good figures are used to aid in

the identification of many of the species. At the end of the bulletin the most important grasses are brought together under six heads. Here there are given of Hay Grasses, 38 species; Pasture Grasses, 36 species; Lawn Grasses, 15 species; Grasses for Wet Lands, 25 species; Grasses for Embankments, 20 species; Grasses for Holding Shifting Sands, 20 species. The last list is of such general importance that it is reproduced here, with the original locality of each species added:

Agrostis coarctata (sea coast, Newfoundland to New Jersey).

Ammophila arenaria (sandy coasts of the Atlantic and shores of the Great Lakes).

Andropogon hallii (sand hills of Nebraska to Texas).

Calamovilfa longifolia (sandy shores of the Great Lakes, and sandy soil of the Western prairies and plains).

Cynodon dactylon (tropical and warm temperate regions of the globe).

Elymus arenarius (seacoasts of Europe and eastern and western North America).

Elymus mollis (Atlantic and Pacific coasts of North America, and shores of the Great Lakes).

Eragrostis obtusiflora (sandy soils in Arizona).

Imperata arundinacea (tropical and warm temperate regions of both hemispheres).

Muhlenbergia pungens (sand hills of Nebraska to New Mexico and Arizona).

Panicum amarum (sandy seacoasts, from Connecticut to Florida and the Gulf).

Panicum repens (shores of the Gulf of Mexico and in the maritime districts of southern Asia, northern Africa, southern Europe and Australia).

Redfieldia flexuosa (sandy districts of Nebraska, Colorado and Kansas).

Spartina patens (salt marshes from Maine to Florida and along the Gulf coast).

Spinifex hirsutus (sandy coasts of Australia, New Zealand and Tasmania).

Stenotaphrum dimidiatum (tropical and warmer regions of both hemispheres).

Thuarea sarmentosa (sandy coasts of Ceylon and northern Australia).

Uniola paniculata (drifting sands of the seashore, from Virginia to Florida and Texas).

Poa macrantha (sand dunes of northwestern United States).

Zoysia pungens (sandy shores of eastern Asia, Australia and New Zealand).

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

CURRENT NOTES ON ANTHROPOLOGY.

INFLUENCE OF SEX ON CRIME.

IN his interesting work 'Juvenile Offenders' (New York, 1897) Mr. W. Douglas Morrison investigates the question why the criminal records of all nations show more male than female criminals. He reaches the conclusion that, after all explanations are allowed, 'the effect of sex itself on crime is permanent.'

An excellent and still more thorough analysis of this important question is presented by Miss Frances Alice Kellor in the *International Journal of Ethics*, October, 1898. She inclines to the opinion that the less criminality of women is largely apparent only, and, to the extent that it really exists, finds its full explanation in sociologic conditions and in biologic facts, not essentially dependent on sex. In other words, that woman's apparent lesser criminalty is not due to inherent moral superiority, but to diminished temptation and opportunity for criminality. Most careful students of ethnology will certainly agree with this.

THE PROGRESS OF ANTHROPOLOGY.

THE President of the Anthropological Section of the British Association this year was Mr. E. W. Brabrook. His address was a review of some of the most striking recent contributions to anthropologic science.

These were the *Pithecanthropus* discussion, late palæolithic finds in France and England, the study of folk-lore, the mythologies of primitive peoples, the growth of religions and the progress of the Ethnographic Survey of Great Britain.

It is gratifying to see that in several passages he fully recognizes the uniformity of action in the human mind, and pertinently asks: "It does not surprise us that the same complicated physical operations are performed by far distant people without any communication with each other; why should it be more surprising that mental operations, often not so complex, should be produced in the same order by people without any such communication?"

A NEOLITHIC LADY.

We should hardly expect to have a handsome and accurate portrait bust of an upper-class lady from Neolithic times. But the marvels of science do not diminish. At the last meeting—in August—of the German Association of Physicians and Naturalists, Professor Kollmann, of Basel, exhibited the bust of a female whose skull and portions of whose skeleton had been exhumed from a Neolithic grave in one of the caverns of southern France. The principles of the reconstruction, as well as modern examples of the method, prove its accuracy. The soft parts of the head and chest can be restored without risk of error.

This Neolithic dame was rather good-looking, and presented the undoubted features of the white race, demonstrating, as Professor Kollmann insisted, that empires may crumble and states decay, but the essential features of each human race persist indefinitely and unchanged.

D. G. Brinton.
University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

The American Mathematical Society will hold its annual meeting at Columbia University, on Wednesday, December 28th. The Chicago Section of the Society will hold its fourth regular meeting at the University of Chicago, on December 29th and 30th.

The American Physiological Society will, as we have already announced, hold its eleventh annual meeting in New York, on Wednesday, Thursday and Friday, December 28, 29 and 30, 1898. The first day's session will be held at the College of Physicians and Surgeons, 437 West 59th Street; the second day's session at Schermerhorn Hall, Columbia University, West 116th Street, partly in conjunction with the American Psychological Association; the third day's session at the University and Bellevue Hospital Medical College, 26th Street and 1st Avenue.

Dr. C. Willard Hayes and Mr. Arthur W. Davis, experts of the Nicaragua Canal Commission in geology and hydrography respectively, have recently returned to Washington after more than a year of field work. Results of their scientific investigations are already promised for meetings of scientific societies.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, is in the field, continuing researches among the Hopi Indians.

Dr. W J McGee, of the Bureau of American Ethnology, and Professor W. H. Holmes, of the United States National Museum, have returned from an ethnologic and archæologic trip through the southern Sierra region of California. Important collections were obtained for the Museum, and interesting observations were made on the surviving California Indians, while the much-discussed archæologic problems of the region received special attention. Both have promised contributions embracing the results of their work to the winter meeting of the Section of Anthropology of the American Association for the Advancement of Science to be held in New York next month.

The *American Naturalist* states that Dr. W. McM. Woodworth has gone to the Samoan Islands in the interest of the Harvard Museum of Comparative Zoology.

An MS. Geometry by Lobachévski has been found at Kazan and is of extraordinary interest as being of much earlier date than anything

published by the illustrious Russian. It is purposed to issue it, inserting as frontispiece the beautiful portrait from the bust of Lobachévski made by *The Open Court* from a photograph furnished by Dr. G. B. Halsted, accompanying his life of Lobachévski in *The Open Court* for July, 1898.

THE Sylvester Memorial Committee has met in London and closed its accounts. The entire amount collected was about £875. It was decided to establish a medal in bronze, to be given every three years, together with the interest on the fund for that period, for distinguished work in mathematics. Of the two appointed to collect subscriptions in America, one, Dr. Cyrus Adler, was present at the meeting in London.

THE French Minister of the Interior has awarded a bronze metal to M. Imbeaux for his contributions to hygiene. Dr. Calmette, of the Pasteur Institute, of Lille, has been made an officer of the Legion of Honor.

PROFESSOR J. MARK BALDWIN, of Princeton University, has been elected a member of the French Institute of Sociology.

DR. D. G. BRINTON is giving, at the Drexel Institute, Philadelphia, a course of lectures entitled 'The New Lands, Present and Prospective, of the United States.'

THE lecture season of the Imperial Institute, London, was inaugurated on November 14th, by a lecture on Trinidad, with some account of the recent hurricane in the West Indies, by Mr. Henry Carraciolo, the delegate from Trinidad to the recent International Zoological Congress.

THE Christmas course of lectures, specially adapted to young people, at the Royal Institution will be delivered this year by Sir Robert Ball, Lowndean professor of astronomy and geometry in the University of Cambridge. The subject will be 'Astronomy,' and the lectures, which will be illustrated by models and the optical lantern, will deal with the sun, the moon, the inner planets, the great planets, shooting stars and new methods. The first lecture will be delivered on Tuesday, December 27th, at 3 o'clock, and the remaining lectures on December 29 and 31, 1898, and on January 3, 5 and 7, 1899.

A MEMORIAL meeting in honor of Dr. William Pepper was held at the University of Pennsylvania on November 29th. If the announcements on the program were carried out, Governor Hastings presided and addresses were made as follows: Dr. S. Weir Mitchell for the trustees of the University, Dr. James Tyson for the medical faculty and the College of Physicians, General I. J. Wister for the institution which bears his name, Daniel Baugh for the archæological and paleontological museums, Hampton L. Carson for the General Alumni Society, Frederick Fraley for the American Philosophical Society, Professor W. P. Wilson for the Philadelphia Commercial Museums and John Thompson for the free libraries of the city. Mayor Warwick will then speak for Dr. Pepper's work as a citizen.

THE death is announced of Sir John Fowler, the engineer, at the age of eighty-one years. Sir John Fowler had charge of a large number of important engineering works, but is best known for the construction of the great bridge across the Firth of Forth.

THE provisional program of the State Science Teachers' Association, for the approaching meeting in New York, is as follows:

Thursday, December 29th. 11:00 A. M.—Opening Session; Address of Welcome, by President Seth Low; Response by retiring President of the Association, Professor E. L. Nichols; Introduction of President-elect, Professor Chas. W. Hargitt. 11:30 A. M.—Paper by Dr. Davenport, of Harvard University, on 'Zoology as a Condition for Admission to College;' Discussion opened by James E. Peabody, Boys' and Girls' High School, New York, followed by Mr. Arthur E. Hunt, Manual Training High School, Brooklyn, and others. 2:15 P. M.—Report of Committee of Nine, by Professor Cooley. 3:00 P. M.—Union Meeting with the American Naturalists. 8:00 P. M.—Annual Address by the President. 9:00 P. M.—Reception.

Friday, December 30th. 9:30 A. M.—Sectional Meetings. *A.* Biology: Chairman, Professor Charles L. Bristol, of New York University; Introductory paper, by Professor G. F. Atkinson, of Cornell University. *B.* Earth Science: Chairman, Professor A. P. Brigham, of Colgate University. *C.* Nature Study: Chairman, Professor Chas. B. Scott, Oswego

Normal School. *D.* Physics and Chemistry: Chairman, Professor Albert L. Arey, Rochester. 11:30 A. M.—Paper by Dr. C. F. Hodge, Clark University, on 'The Active Method in Nature Study.' 2:00 P. M. —Paper by Mr. Arthur G. Clement, of Regents' Office, on 'The use of the Microscope in Secondary Schools.' 2:45 P. M.—General Discussion of the Report of the Committee of Nine. 8:00 P. M.—Meeting, with lecture, in the American Museum.

THE Chemical Society gave a banquet on November 11th at the Hôtel Métropole in honor of the past Presidents who have been Fellows for half a century—namely, Sir Joseph Henry Gilbert, 1841; Sir Edward Frankland, 1847; Professor William Oding, 1848; Sir Frederick Augustus Abel, 1848; Dr. Alexander William Williamson, 1848; and Dr. John Hall Gladstone, 1848. Professor Dewar, LL.D., F.R.S., the President of the Society, was in the chair, and a company of 260 guests were present. Congratulations were presented from the Russian Chemical Society and the German Chemical Society. The President, Professor Dewar, made an address to which each of the past Presidents replied. Speeches were also made by Sir William Crookes, Professor Ostwald, Lord Reay, Lord Lister, Professor Foster, Dr. Thorne, Mr. Haldane and Dr. Böttinger.

THE opening meeting of the present session of the Royal Geographical Society, London, was held on November 14th, and was devoted to the subject of Antarctic exploration. The address of the President, Sir Clements Markham, reviewed the progress of geographical work during the year, but was chiefly directed to the subject of Antarctic exploration. He spoke of the expeditions under M. Gerlache and Mr. Borchgrevink as not likely to secure important results, but the German expedition of 1900 under Dr. Erich von Drygalski would be admirably organized under the auspices of the German government, and Great Britain would be left in the rear if it were not prepared to send an expedition to cooperate with that from Germany. He announced that the Council of the Society would subscribe $5,000 towards the expedition. Further addresses were made by Professor Foster, Professor Rücker, Sir Joseph Hooker, Sir Erasmus Ommanney, Sir Leopold McClintock and Admiral Sir W. Wharton. Since the meeting Mr. Alfred Harmsworth, the publisher, whose interest in arctic exploration has been shown by the Jackson-Harmsworth expedition, has subscribed £5,000 towards the fund.

AT the monthly general meeting of the Zoological Society of London, held on November 17th, at the office, in Hanover-square, Dr. Günther, F.R.S., Vice-President, in the chair, it was stated that there were 409 additions to the Society's collection of living animals during the months of August, September and October, of which 210 were acquired by presentation, 44 by purchase, 128 received on deposit, 24 had been born in the garden and three received in exchange for other animals. It was further stated that the number of visitors to the Society's gardens during the months of August, September and October had amounted to 267,799.

THE annual meeting of the Michigan State Horticultural Society will be held in Ann Arbor, December 6th, 7th and 8th. The program includes papers by Professor Albert B. Prescott, 'Fruit Acids;' Professor Frederick G. Novy, 'Preserving Fruits;' Professor Paul C. Freer, 'Beet Sugar and Sugar Beets;' Dr. James B. Pollock, 'The Ripening of Fruits;' Professor Frederick C. Newcombe, 'What are Fruits?'

THERE will be, under the auspices of the government, an exposition of arts and manufactures in Venezuela, opening on January 1, 1900.

THE Massachusetts Horticultural Society offered a large number of prizes for the herbarium exhibition, on November 25th and 26th, at the Horticultural Hall, Boston. The premiums were given for school gardens, school herbariums and children's herbariums, the latter competition being open to all children in the State not over eighteen years old.

THE plague returns for the week ended the 11th inst show a slight increase in Bombay city. Dharwar district shows a large increase, over 2,200 deaths being reported.

DR. HAYDEN, a medical officer who visited India during the plague, arrived in Victoria in July, bringing with him plague microbes. The government, fearing a repetition of the Vienna outbreak, demanded the surrender of the mi-

crobes. This Dr. Hayden refused to do unless he received £300 compensation, and the government has, consequently, seized and destroyed them.

THE following extraordinary statement has been given to the press: "Mrs. Mary Baker Eddy, discoverer and founder of Christian Science, has just completed the examination of a class of about seventy of the active workers in Christian Science mind healing to confer upon them the degrees of the Massachusetts Metaphysical College as healers and teachers of this system of medicine, whose only crowned head is divine sovereignty, whose only priest is spiritualized man."

AT the funeral of the late John W. Keely his work was eulogized and the plans of the Keely Motor Company promoted by four clergymen of the Methodist Episcopal Church. Rev. W. C. Best, D.D., said: "The wave of sorrow caused by Mr. Keely's death came to all lands and reached all shores. Thousands of investigators and scientists, though not visibly present, are gathered in spirit around his casket." Rev. W. J. Colville said: "When that mighty force shall cause suffering and poverty to cease on earth, then will statues be reared to Keely and he will be looked upon as one of the greatest men, not only of America, but of the world."

WE learn from *Electricity* that Messrs. Irving E. Burdick and Francis G. Hall, of the electrical engineering department of Yale University, have designed a submarine arc lamp of from 1,000 to 2,000 candle-power. The lamp is absolutely water-tight, with an inner and outer globe, the upper part of the outer globe being hermetically sealed to the metal cylinder containing the feeding mechanism by means of rubber gaskets and rings. The feeding mechanism in this lamp differs from that of the ordinary arc lamp in that it is enclosed in a cylinder both water- and air-tight. From the top of the cylinder, through a carefully-packed aperture, issue the two insulated wires, which, for convenience, are bound together into a cable. The lower portion of the lamp is protected by an eight-wire guard. Tests of the lamp at the depth of twenty-five feet are said to have been very satisfactory.

THE botanical expedition to the La Plata and San Juan Mountains, of Colorado, says the *Botanical Gazette*, was in the field four weeks last summer, the time being unexpectedly shortened. During that time the three collectors, Professor F. S. Earle, C. F. Baker and S. M. Tracy, secured about 25,000 specimens. Eighteen uniform sets (all sold in advance) will be distributed shortly, besides which there will be a number of partial sets (a few yet remaining unsold). It is believed that the series is more than usually valuable, both on account of the biological importance of the region and from the care exercised to secure all available forms and variations. There are also a number of new species, and quite a number of rare ones, including *Ranunculus Macauleyi* in flower and fruit, *Astralgalus Wingatensis*, *Cerastium arvense*, *Fuegianum*, *Fendlera rupicola* and others. The sets will form the basis for a report upon the season's work to be issued with the aid of Dr. E. L. Greene.

UNIVERSITY AND EDUCATIONAL NEWS.

THE late Edward Austin, of Boston, has given by his will $1,100,000 for public purposes; $500,000 is left to Harvard University, $400,000 to the Massachusetts Institute of Technology, $30,000 to Radcliffe College, $30,000 to Roanoke College, and $30,000 to the Tuskegee Normal and Industrial School. The income from these large bequests is to be used for scholarships. The sum of $10,000 is also given to the bacteriological laboratory of the Harvard Medical School.

MR. J. N. TATE, of Bombay, has guaranteed 1,250,000 Rs per annum for advanced education in India, mainly for post-graduate study and scientific research. *The Indian Textile Journal* says: "The examples of other countries, and especially of America, have offered every encouragement;" and it is further remarked: "The systematic instruction of teachers of handicraft on an adequate scale in India has yet to be begun."

IT is proposed that the bequest to Cambridge University of £10,000 by Mr. Allen, the income to be applied for a scholarship, should form the endowment of a student to be called the Allen Student, whose duty it shall be to devote him-

self to literary or scientific research. It will be awarded in alternate years in the sciences and humanities and is of the value of £250.

THE family of the late Dr. John Hopkinson, in addition to their gift of £5,000 towards the engineering laboratory at Cambridge, have given £1,600 to Owens College, Manchester, where Dr. Hopkinson was a student. The money is to be used for building a dynamo house connected with the new physical laboratory.

THE Twelfth Annual Convention of the Association of Colleges and Preparatory Schools of the Middle States and Maryland was held on Friday and Saturday at Columbia University, New York. The subjects chosen for discussion were the teaching of history and of civics in the secondary schools and the requirements for admission in engineering colleges. The discussion of the last-mentioned topic was opened by Professor R. H. Thurston, of Cornell University, who was followed by President T. M. Drown, of Lehigh University, Professor W. H. Spangler, of the University of Pennsylvania, and Professor D. G. Carhart, of the Western University of Pennsylvania. The discussion of the subject was continued by Secretary Dewey, of the Regents' Office; President Warfield, of Lafayette College; Chancellor Holland, of the Western University of Pennsylvania; Chancellor McCracken, of New York University, and President Low, of Columbia University.

THE number of students enrolled in the departments of the University of California at Berkeley is 1,565, over 150 more than at the corresponding time last year. The graduate department has an enrollment of 149 students.

THE number of undergraduate students at Oxford for the present term is 3,412, four more than last year. The number of matriculations was twenty-one greater than last year, but the B. A. was conferred on only 554 students as compared with 580 in 1897. The number of resident members of congregation is 461.

THE number of resident members of Cambridge University, both graduates and undergraduates, is this term 3,524, a decrease of twenty-one as compared with last year. The stationary condition of the two great universities, when compared with the rapid growth of the American and German universities is doubtless in a measure due to the establishment of provincial universities, but it may also in part be attributed to the fact that the educational systems of Oxford and Cambridge do not fully meet modern requirements.

THE *Journal of Education*, London, gives in its last issue some account of the extension of commercial education abroad. For some time already an annual Congress has been held of the directors of commercial schools in the Imperial Higher Commercial School at Tokio. At that held in May last, representing seventeen cities, the draft of a statute regarding industrial, commercial and agricultural education was submitted by the responsible Minister for discussion; and, in an extraordinary session of the Diet, a bill has this year been passed which allocates 119 million yens (about $60,000,000) to the subsidizing of the intermediate commercial schools throughout the Empire. Signor Ferdinando Bocconi has placed at the disposal of the Milan Polytechnic a sum of 400,000 lire ($80,000) for the establishment of an 'Istituto superiore di commercia,' or Commercial University, which shall have a local habitation annexed to the Polytechnic. Its aim shall be to train traders of the first rank, in view of a diploma granted for knowledge of the economic conditions and languages of the most important countries, of chemistry, commodities, commercial geography, commercial, industrial and maritime law, customs and railway legislation, banking, insurance and business methods. A project is also in hand for the establishment of a Commercial University at Moscow. It is expected that a Council will be appointed and regulations framed before the end of the present year.

OWING to the resignations, during the summer, of Dr. Henry P. Quincy and of Dr. Elisha H. Gregory, Jr., the department of histology and embryology at the Harvard Medical School, under Professor Minot, has been reorganized. Dr. Schaper remains as the demonstrator, and the following corps of assistants have been formed, the names being arranged in the order of seniority. Dr. John L. Ames, Dr. Frederick

A. Woods, Dr. Roger T. Atkinson and Dr. F. R. Stubbs. Dr. Quincy was connected with the department from its inception to the present time, and its rapid development has depended very much upon his zeal and devotion. This loss will be long regretted.

MR. F. G. HOPKINS, late demonstrator of physiology at Guy's Hospital, has been appointed to the new university lectureship in chemical physiology at Cambridge University.

DISCUSSION AND CORRESPONDENCE.

SHALL THE INTERNATIONAL EQUIVALENT OF 'ANLAGE' BE PRIMORDIUM OR PROTON?

TO THE EDITOR OF SCIENCE: In *Nature*, for August 25, 1898, p. 390, appeared a communication from Arthur Willey entitled 'What is Anlage?' He well remarks:

"To be obliged, on every occasion, to write 'Anlage' in inverted commas s a standing testimony to the deficiency of our scientific nomenclature and a constant offence to our æsthetic susceptibilities."*

After pointing out the more or less obvious objections to *forecast*, *fundament* and *rudiment*, he concludes:

"The word that commends itself to me as being at once accurate and well-sounding is *primordium*, and I trust some of your readers will criticise it whether favorably or unfavorably."

I have hesitated to respond to the foregoing cordial invitation because the alternative term in the title of this note was first, in recent times, at least, proposed by me. Nearly six years ago, in an article on the Brain ('Reference Handbook of the Medical Sciences,' IX., p. 104, note), *proton* was employed to 'designate the primitive, undifferentiated mass or rudiment of a part.' It was also introduced in my review of two works on Human Embryology (*The Nation*, LVI., No. 1454, p. 350):

"One author translates Anlage *fundament*. The other adopts it as an English word, regardless of its multifarious and incongruous senses, the confusion that attends its pronunciation and spelling, and the improbability of its acceptance by French embryologists. Neither seems to have thought of reverting to Aristotle, whose phrases, *τὸ πρῶτον*; *ἡ πρώτη ὕλη*; *ἡ πρώτη αἰτία*, suggest the short word *proton*, already familiar in numerous compounds, and eligible for adoption into any modern language."

Proton was also referred to in my 'Neural Terms International and National' (*Jour. Comp. Neurology*, VI., 289, December, 1896); and in 'Some Neural Terms,' 'Biological Lectures' [Marine Biological Laboratory], 1896–1897, p. 158. It has been employed by S. H. Gage, address as President of the American Microscopical Society, 1895 (SCIENCE, August 23d, p. 211); by Mrs. S. P. Gage, 'Comparative Morphology of the Brain of the Soft-shelled Turtle and the English Sparrow' (*Proc. Amer. Micros. Soc.*, 1895, p. 228); by B. B. Stroud, 'The Development of the Cerebellum in Man and the Cat,' *Jour. Comp. Neurology*, V., July, 1895, p. 88; by Joseph Collins, Translation of Jakob's 'An Atlas of the Normal and Pathological Nervous Systems,' 1896, p. vii.; by C. J. Herrick, *Jour. Comp. Neurology*, IV., p. 6, April, 1894; by A. Meyer, *idem*, VIII., p. liv.; and, with editorial commendation, in the *Philadelphia Medical Journal*, May 7, 1898, p. 798. It is defined in Gould's 'Medical Dictionary.'

These uses of *proton* were evidently unknown to Mr. Willey; doubtless he was likewise unaware that the very question propounded in the title of his note had been considered in the article, 'Inquiries Regarding Current Tendencies in Neurological Nomenclature,' by C. L. and C. J. Herrick, in the *Journal of Comparative Neurology*, VII., 162–168, March, 1898. In a circular dated December, 1896, which was 'mailed to about one hundred and fifty of the leading neurologists and anatomists of the world,' was included the following item:

"Kindly underscore your preference among the following, making any comments or additions which may seem best to you: (a) *Proton*, *fundament*, *rudiment*, for the German *Anlage*."

To this query were received forty-two replies, tabulated on p. 166: *Beginning*, *origin* and *foundation* had each one American advocate; *fundament*, six (three American and three European); *rudiment*, nine (five and four); the retention of *Anlage* was favored by eleven (eight and three); but *proton* was preferred by thirteen (seven American and six European).

Had the above facts been known to Mr. Willey he would, of course, have included *proton* among the possible equivalents for *Anlage*. Were *proton* not available *primordium* would be acceptable to me. I venture to express the

*The needless adoption of German words into English had already been vigorously reprobated by Schäfer. *Nature*, August 13 1896; p. 341.

hope that the shorter word of Aristotle may find favor with Mr. Willey.

Burt G. Wilder.

Ithaca, N. Y., November 18, 1898.

POST-GLACIAL CONNECTICUT.

To the Editor of Science: A note in your issue of the 28th ult. makes my 'Postglacial Connecticut at Turner's Falls,' in the Chicago *Journal of Geology* (July–August), 'invoke the agency of ice' to cut the abandoned gorges at the Bird Track Quarry and Poag's Hole. This is just only in so far as it is true that had there been no glacier there would be no postglacial superposed gorge. The gorge, like all those of its class, was cut by the river and a clear photograph is reproduced, showing the visible water wear on these rocks in a region where all others are beautifully rounded by glaciation.

Mark S. W. Jefferson.

Brockton, Mass., November 11, 1898.

SCIENTIFIC LITERATURE.

Handbuch der physiologischen Optik. H. von Helmholtz. Hamburg und Leipzig, Leopold Voss. 1896. Second Revised Edition. Pp. xix+1334. M. 51; Bound, M. 54.

The phenomena of vision are so far-reaching and at the same time so organically related that they may almost be regarded as the subject-matter of a separate science. It is neither possible to include them under physics, under physiology or under psychology, nor to distribute them among these sciences. The photochemistry of the retina, the anatomical and histological data, and the comparative and evolutionary relations, add still further to the range of the subject. On vision is based one of the more important departments of medicine; for ophthalmology can in most cases not only offer a correct diagnosis, but also a cure. Probably a majority of the whole population needs its services, and if we add the hygiene of the eye, including the proper lighting of schools, the proper printing of books, etc., there is no one to whom the scientific study of vision is not of practical importance. The phenomena of vision are further factors in the production and appreciation of the great plastic arts — painting, sculpture and architecture. Finally, the world in which we live is before all the world we see.

If there be a science of vision, von Helmholtz should be honored as its founder, and it should date from the completion of the *Physiologische Optik* in 1867. It is true, the doctrine of special creations belongs to the past. Like other departments of knowledge, vision has had a long history and a gradual development. von Helmholtz found at hand not only the greater part of the materials for his structure, but also many of the designs. From the side of physics he had the series of contributions from Kepler, Descartes, Newton, Lambert, Young, Brewster; from physiology there were Haller, Priestley, J. Müller, Plateau, Volkmann, Purkinje; from philosophy Berkeley; from art da Vinci and Goethe—to mention but a few of many names. Contemporary with von Helmholtz worked Aubert, Hering, Listing, von Graefe, Brücke, Vierordt, Donders, von Bezold and many more. But of them all von Helmholtz alone saw the range and unity of the subject, and prepared one of the few books that make an epoch. So well was his work performed that it has scarcely had a successor—only Aubert's *Grundzüge der physiologischen Optik* deserves to be mentioned—and it remained for von Helmholtz himself, in old age, with energies diverted to other channels, to write a new edition of his great work.

To give in a review an account of the contents of a book extending to 1,300 pages, written with great conciseness and covering a range of subjects so wide, is evidently infeasible. Still less possible would it be to enter into critical discussion—an article might be written on each of a hundred topics. This notice must be confined chiefly to the new edition, and the eulogy appropriate to the first edition must be tempered with criticism.

Publication of this edition was begun in 1888. In the course of about a year three parts were issued, treating of the anatomy and dioptics of the eye. About forty pages are here added in addition to substitutions for material omitted, and thorough revisions throughout. The pages in the new edition are, however, somewhat smaller than in the old. This Section concludes with the description of von Helmholtz's great

invention, the ophthalmoscope. The parts then began to appear more slowly, at intervals of about two years, until the death of von Helmholtz in 1894. The eighth part had then been completed, extending the work to page 645. The part on sensations of light runs from page 231 to page 575, being enlarged by more than one hundred pages. Much new material, especially work on intensity done in von Helmholtz's laboratory, is here added. The final part, on perceptions and judgments, mostly edited by Professor König after the death of von Helmholtz, has scarcely been altered. Professor König states that it was not the author's intention to make many changes in this part, even had he been able to continue the revision. The work concludes with an index of the literature, containing 7,833 titles, compiled by Professor König.

It seems ungracious to do other than accept this new edition of a master work with sincere thankfulness. Even though it may not as completely represent contemporary knowledge of the sense of sight as did the first edition, thirty years ago, ought we not to be truly grateful to the author for his elaborate revision? Grateful we should doubtless be and appreciative of the heroic effort of von Helmholtz. But we owe truth to the dead, and I must state my own view to be that little or nothing, or worse than nothing, has been accomplished by this revision. It has happened in cases other than this that a classic work making a remarkable contribution to science has ultimately become an obstacle to to the advance of science. Kant creates a work on epistemology that alters the entire groundwork of metaphysics. After a hundred years we find the cry prevalent in Germany 'back to Kant,' and back they go, not only to the *Critique* as representing the best thought of the eighteenth century, but as though all its trivialities were of contemporary importance.

The *Physiologische Optik*, the publication of which was begun in 1856 and completed in 1867, is one of the few classics in the history of science. It summarized the existing state of knowledge with rare completeness and lucidity, and made remarkable original contributions to the advancement of knowledge. But a work of such magnitude and genius actually prevents the preparation of new books truly reflecting the present conditions and conflicting claims of facts and theories. The physicist, the physiologist, even the psychologist, is apt to regard the gospel according to Helmholtz as infallible. This is the inevitable, against which even the gods do not contend. But the publication of a new edition dated 1896 tends needlessly to prop up the Procrustean bed, confining the growing members. Since 1860 the doctrine of evolution has been established; since 1860 modern psychology has been developed. The '1896' on the title-page is harmful to science; unfair to von Helmholtz himself.

Even the title of the book is an anachronism. Physiological optics correctly describes only that part concerned with the eye as an optical instrument. Optics is a department of physics and no longer includes the psychological phenomena of vision. When von Helmholtz himself prepared a little later a work on the sense of hearing, in many ways a companion volume to that on vision, he did not call it *Physiologische Akoustik*, but *Tonempfindungen*. The literature on vision prior to 1867 is small compared with that subsequent. Thus on the perception of color 163 titles are given in Professor König's bibliography as published earlier than 1867, and 1034 between that and 1894. The newer literature is scarcely incorporated, and in so far as this is attempted a false perspective is given by devoting many pages to work done by Professor König, Dr. Brodhun and others in von Helmholtz's laboratory, while work of equal importance done elsewhere is ignored. The injustice done, for example, to Hering, is very great. In various points of conflict von Helmholtz replies to Hering, but in such an inadequate fashion as to show either carelessness or a complete lack of appreciation of the value of evidence. The possibility that he might be wrong or that progress had been made seems scarcely to occur to him.

I may note two of these points of difference between Hering and von Helmholtz—the perception of color and the perception of space—to illustrate the tenacity with which von Helmholtz clung to his early views in spite of accumulating evidence against them. The Young-Helmholtz theory of color-vision is well known, being, in fact, imposed annually as ascertained

truth on thousands of students in their introductory courses of physics and physiology. When von Helmholtz elaborated the hypothesis it was of great value in coordinating the then known phenomena and in giving a basis for further research. But forty years have brought many changes, and if the hypothesis were now proposed anew by an unknown man it would not find a single adherent. No modern student of organic evolution can conceive how the three-fiber mechanism could develop from a unicellular organism already sensitive to light. No psychologist can conceive how three kinds of fibers make us see three primary colors as white light; they would more probably lead us to see white light as three colors, I should suppose. All the newer phenomena—the spectrum of faint light, color-blindness, contrast, after-images, the variations in the field of vision, etc.—not only do not support the hypothesis, but must be subjugated to it by unlikely subsidiary hypotheses. The phenomena of space perception are too complex to enter into here, but the 'empiristic' theory, of which von Helmholtz was properly proud in the sixties, seems now, after the writings of James, Ward, Stumpf and others, particularly naïve.

With some reluctance I must state that not only are the theories of the *Physiologische Optik* in large measure outgrown, but that in many cases the observations cannot be verified. In subjects in which I have myself worked—after-images, the discrimination of intensity, conflict of the fields of vision and others—new methods have given different and probably more correct results. This is the natural course of science. The work of a great investigator, if vital, must be the ladder by which we climb, but which we afterwards discard. The *Physiologische Optik* is still a great storehouse of facts and observations of contemporary importance, but we should regard it as closed thirty years ago.

The bibliography compiled by Professor König is an extremely useful piece of work, but I see no adequate reason for appending it to the *Physiologische Optik*. It may be delusive in leading the thoughtless to suppose that von Helmholtz had considered all these works; it makes the book needlessly bulky and expensive; it is compiled chiefly at second hand, with many omissions and numberless minor errors.* Such an index should be published separately, and, if possible, revised and brought up to date every few years.

The criticisms that I have ventured to make apply only to the revision of the *Physiologische Optik*. If the first edition had been reprinted without alteration there would be nothing to express but admiration for a work of genius almost unrivalled in the history of science, and for a man of genius whose intellect was so profound and so far-reaching that of his contemporaries only Darwin stands beside him.

J. McKeen Cattell.

Columbia University.

Elementary Botany. By Geo. F. Atkinson. New York, Henry Holt & Co. 1898. 12mo. Pp. xxiii+444.

This latest and best of elementary text-books of botany is a thoroughly commendable work, and reflects high credit upon the author and upon the publishers. In pleasing contrast to the larger number of books with similar titles and kindred scope it is fresh, accurate, comprehensive and readable. It must have a heavy sale as soon as teachers of botany become acquainted with its merits, for in no other American elementary botany now before the public is the subject-matter so thoroughly covered and the illustration so illuminating and suggestive.

The text has been classified by its author under three captions, physiology, morphology and ecology, in the order given, a modification of the ordinary arrangement. In the first

* Thus, in regard to American writers eighteen references are given to Professor Le Conte, but his book on 'Sight' is not included. A comparatively unimportant article by an American author is quoted three times, probably by accident. We find 'Bowditsch' four lines after the name has been correctly given. My own name is given twice within five lines spelled incorrectly in two different ways. Mrs. Franklin's name occurs four times, each time differently. Professor Le Conte Stevens' name occurs five times in four different ways, never quite correctly. One of Professor Stevens' articles is said to be in the 'Amer. Journ. of Sc. Vol. XXIII.,' and the continuation of the article in the next number of the same journal is said to be in 'Sill. Journ. XXIII.' Indeed, I have noted sixteen different ways in which *The American Journal of Science* is referred to.

part protoplasm at work is the theme, and the various phenomena of cell-mechanics and cell-physiology are succinctly and skilfully described. Here are to be found the discussions of osmose, turgescence, root-pressure, transpiration, movement of liquids, diffusion, respiration, photosynthesis, growth and irritability, for all of which the splendid presentative abilities of the author are elicited. From the almost unlimited store of information to be had upon these subjects, Professor Atkinson has wisely selected, carefully condensed and tactfully eliminated so that his finished chapters bear the testimony to his unusual powers of criticism and compilation. Here and there original material is included, but always with modesty, and not at all in the far too common spirit which deems all personal results of value above any of the results of others.

In the chapters on morphology the same fine selective instinct is displayed and the completed lessons, extending over a representative series from the pond-scums to the Hawkweeds, are quite the best of their sort that have come under the observation of the reviewer. They are more than a bare enumeration of laboratory processes, more than a story about the plants and their life histories. They are a breathing, vital presentation of the principal matters of interest, structural, developmental and adaptational, which the young student should know and should remember. In the chapter on ferns the author has embodied many results of his own well-known and beautiful researches and, as elsewhere, has contrived always to use illustrations that illustrate, Figs. 231 and 232 being the only ones that can be described as inartistic, while all are scientifically adequate. The selection of types for study among flowering plants is particularly happy, and such varieties as can be obtained generally over at least the northern United States are emphasized.

The chapters on ecology are peculiarly interesting to the reviewer, since the field is one that he has attempted to cultivate, and in them many of his own results are included. Perhaps even under these circumstances he will be pardoned for speaking with something akin to enthusiasm, for certainly not even in Kerner or Warming has such a charming presentation of the subject been accomplished. The matter is classified under the following chapter headings: winter buds, growth of woody shoots, leaf arrangement, seedlings, further studies in nutrition, dimorphism of ferns, formation of early spring flowers, heterospory, pollination, seed distribution, struggle for occupation of land, soil formation in rocky regions and in moors, zonal distribution of plants, plant communities, seasonal changes, adaptation of plants to climate. All of the chapters are finely illustrated with original figures in similigravure, including a number that are destined to become classic, as, for example, Fig. 440 of the fairy ring fungus, Fig. 484 of an atoll moor and Fig. 503 of the walking-fern. Such a series of chapters ought to renew the youth of the driest botanical pedagogue that ever droned through his Gray's Manual by the aid of an 'artificial key,' and it ought to do more for botanical instruction in the schools of America than has been done by any book since Bessey's Botany.

With so much of good to say about Professor Atkinson's 'Elementary Botany' it would be a pity to add more than the merest soupçon of unfavorable comment. A few things might have been done better. Generic names have, no doubt, as much right to their capital letters as have the honored names of the author and publishers: 'elementary botany by g. f. atkinson, published by henry holt and co.' looks absurd and so does the sentence 'comparison of selaginella and isoetes with the ferns'—at least to the eyes of the reviewer. It is a blunder to speak about the *roots* of *Corallorhiza*, for the coral-root orchid has no roots at all, the underground micorhiza-infested region being the rhizome. And one cannot help regretting that the author should so constantly use 'will' and 'shall' in an unrhetorical manner, as in the beginning of paragraph 3. Paragraph 718 will scarcely do; it is neither science nor poetry. No doubt it was intended to be pictorial, but the effect is *reporteresque*; it reminds one of the society column of the Sunday paper.

None of these trifling blemishes interferes with the general cleverness, scientific accuracy and immense utility of the new 'Elementary Botany.' The publishers are to be congratu-

lated upon having brought out in these latter days such a virile volume.

CONWAY MACMILLAN.

SCIENTIFIC JOURNALS.

American Chemical Journal, November: 'On the cause of the retention and release of gases occluded by the oxides of metals:' By T. W. Richards. The author has studied the conditions under which the gases are given off and suggests a theory to account for the observed facts. 'New experiments on the quantitative synthesis of water:' By E. H. Keiser. The author has weighed the hydrogen and oxygen used and the water formed, and obtained figures which gave an atomic weight of 15.88 for oxygen if hydrogen is taken as 1. 'On the metaphosphimic acids:' By H. N. Stokes. The homologous series of compounds of the general formula $(PNCl_2)_n$ when saponified yield acids; but the higher members do not yield acids of the same general structure as the lower ones, a fact for which the author suggests an explanation based on the Baeyer 'tension theory.' 'The ethers of toluquinone oxime and their bearing on the space isomerism of nitrogen:' By J. L. Bridge and W. C. Morgan. 'On the claims of davyum to recognition as a chemical element:' By J. W. Mallet. The evidence seems to be against the existence of this element. J. E. G.

THE *American Naturalist* for November opens with a paper by Professor Henry S. Williams entitled 'Variation versus Heredity,' maintaining the views previously described by him in SCIENCE; Professor William Patten contributes an article on the theory of color vision described by him at the American Physiological Society in 1897 and the American Morphological Society in 1896; Professor W. J. Beal gives examples of peculiar dispersion of seeds and fruits, and Professor C. B. Davenport summarizes the advance of biology in 1896 from the *Année biologique*.

THE first number of the second volume of the *American Journal of Physiology*, issued on November 22d, contains the following articles:

'On the Excretion of Kynurenic Acid:' By Lafayette B. Mendel and Holmes C. Jackson, Ph.B.

'On the Modification of Rigor Mortis resulting from Previous Fatigue of the Muscle, in Cold-Blooded Animals:' By Caroline W. Latimer, M.D.

'On the Relation of the Blood to the Automaticity and Sequence of the Heart-Beat:' By W. H. Howell.

'On the Relation of the Inorganic Salts of Blood to the Automatic Activity of a Strip of Ventricular Muscle:' By Charles Wilson Greene.

MESSRS. ROBERT AIKMANN & Co., Manchester, announce the publication of a new periodical, '*Science Work*,' edited by Mr. Walter Jeffs. It will be issued monthly and is intended to do for science what the *Review of Reviews* is doing in a wider field. The annual subscription is only 2/6—60 cents.

AT the winter meeting of Section H, American Association for the Advancement of Science, held at Ithaca, December 28, 1897, a committee was appointed to found a journal designed to promote the interests of anthropology in America. The committee held several meetings, conferred with publishers, and reported to Section H at the Boston meeting of the Association. It has been decided to undertake the publication, provided a sufficient number of persons indicate their willingness to support the movement by subscribing for the first volume. The journal will be issued in quarterly numbers of about two hundred octavo pages, forming an annual volume of about eight hundred pages, the first number to appear in January, 1899. The subscription price will be $4. It will embrace: (1) papers pertaining to all parts of the domain of anthropology, the technical papers to be limited in number and length; (2) scientific notes and news pertaining to anthropology, and (3) a current bibliography of anthropology. The new journal will succeed the *American Anthropologist*, of the Anthropological Society of Washington, and the name of this journal may be adopted or a new name selected—'*American Journal of Anthropology*' and '*Anthropology*.' The journal will be published by Messrs. G. P. Putnam's Sons and conducted by the following editorial board: Dr. Frank Baker, Dr. Franz Boas, Dr. Daniel G. Brinton, Dr. George M. Dawson, Dr. George A. Dorsey, Professor W. H. Holmes, Major J. W. Powell, Professor F. W. Putnam; F. W. Hodge, *Secretary* and *Managing Editor*.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held November 2d, thirty-seven persons present. Professor Alpheus Hyatt exhibited the lower jaw of a whale, *Mesoplodon* sp., that came ashore on the beach inside the harbor of Annisquam, Mass., in August, 1898. The specimen was a young female; after the removal of the blubber, the length, measured along the side of the body, from the re-entrant angle of the tail-fin to the end of the lower jaw, was twelve feet, two inches. The lower jaw projected slightly beyond the upper jaw. A narrow crease was observed on the under side of the throat along the median line. The shape of the body was more or less laterally compressed oval. A single cresentic blow-hole was situated in a depression on the top of the head. The greatest diameter of the nasal pouch was about four inches.

According to True there are but two records of *Mesoplodon* from the north Atlantic coast. The first of these refers to a specimen from Nantucket, and is noticed by Professor Louis Agassiz in the 'Proceedings' of this Society, 1868, Vol. 11., p. 318. This specimen was sixteen feet long, and the skull and other bones, preserved in the collection of the Museum of Comparative Zoology, indicate a female somewhat older than the Annisquam specimen. The skeleton of the second specimen, taken at Atlantic City, N. J., in 1889, is in the United States National Museum. The skeleton of the Annisquam specimen will be preserved in the Museum of the Society.

Dr. R. T. Jackson spoke on localized stages in development in plants and animals. This paper will be printed as No. 4, Vol. 5, of the Memoirs of the Society.

SAMUEL HENSHAW,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON—297TH MEETING, NOVEMBER 19.

DR. F. W. TRUE exhibited a copy of an entomological journal published in Japan, explaining that it was the first journal of its kind to appear in that country.

Mr. E. L. Morris narrated an extraordinary feat of climbing in the case of a small green snake, whereby the animal ascended a vertical polished nickel pipe for some distance above the tank in which it was confined.

Dr. L. O. Howard displayed three entomological posters issued in handsome form by foreign governments. Two, devoted to the Colorado potato beetle and the San José scale, were produced by the German authorities, and one, illustrating a destructive grain beetle, by the Russian.

Dr. Cleveland Abbe presented a paper entitled 'Climate and the Corn Crop,' illustrated by numerous charts and statistical tables. He discussed the various factors affecting the crop production in different portions of the country, with special reference to climatology.

Mr. Herbert J. Webber, in the course of 'A Comparison of the Types of Fecundation of Flowering Plants,' pointed out that zoidiagamous fertilization, by means of motile spermatozoids was, so far as known, confined to the Cycadales and the Ginkgoales among the Gymnospermæ. He described briefly the two forms of the process, porogamy and chalazogamy, found among the higher flowering plants, illustrating his remarks by numerous drawings of special cases.

F. A. LUCAS,
Secretary.

HARVARD UNIVERSITY: STUDENTS' GEOLOGICAL CLUB, NOVEMBER 8, 1898.

MR. W. E. HOBBS described some Cambrian fossils which he collected as East Braintree, Mass., from an outcrop that Professor Crosby places stratigraphically above the quarry outcrop. They include young individuals of *Paradoxides harlani*, shields of *Agraulus quadrangularis*, *Ptychoparia rogersi*, *Hyolithes haywardensis* (Grabau, not yet published), and an indistinct Obolella. Under the title of 'A new Species of Cystid,' Mr. L. LaForge discussed some specimens from the middle Chemung, at Alfred, N. Y. All the specimens, about one hundred in number, have been collected from boulders within an area of two or three square miles. The perfect specimens show the characteristics of Agelacrinus, but differ chiefly from the known species in the ambulacra.

Geological Conference, November 15, 1898. Mr. J. E. Woodman presented brief notes on two local features, 'Fifty Years' Change in Lynn Beach,' and 'A Section through the Newtonville Esker.' Thirty years ago, according to the statement of a stage driver of that time, the road across Lynn Beach, from Lynn to Nahant, was passable for the stage only at low tide. The constructive action, which has resulted in the present, broad, high beach, takes place chiefly during winter storms and on the east side. Attention was directed to some significant bedding recently exposed in a section through the Newtonville esker. The subglacial stream cut the ice on the outside of its curve, just as meandering streams cut their banks to-day, for the cast of the old channel shows higher beds unconformably overlapping lower ones on the outside of a bend.

Mr. A. W. Grabau spoke on the 'Siluro-Devonian Contact in Western New York.' In the region considered, the Onondaga limestone, at the base of the Devonian, has generally been held to rest unconformably upon the Water-lime, at the top of the Silurian. Five sections exposed in the Buffalo cement quarry, near Buffalo, N. Y., tend to show that these beds are not only unconformable, but also that they are separated, locally, by a thin layer of conglomerate. The so-called 'bull-head' limestone, which forms the upper seven feet of the Water-lime, contains few fossils except near the top, where the following have been found: exterior molds of a new coral; two species of Leperditia, and five species of brachiopods. All the species show Lower Helderberg affinities. The evidence afforded by fossils and by stratigraphic position indicates that this bed is the western extension of the Lower Helderberg, and that the overlying limestone conglomerate, with quartz sand in the cement, is the equivalent of the Oriskany. Mr. Grabau proposes to call this important capping member of the Silurian the Greenfield limestone. The name is taken from the town in Ohio near which this bed both attains strong development and afforded the first fossils described from it.

One portion of the contact discussed exhibits an irregular, ancient fissure about ten feet deep and up to two feet in width. This fissure penetrates the entire stratum of the Greenfield limestone and a portion of the Water-lime, and is filled with compact, quartz sandstone, containing angular fragments of the limestone.

J. M. Boutwell,
Recording Secretary.

NEW BOOKS.

A Treatise on Universal Algebra with Applications. Alfred North Whitehead. Cambridge, University Press; New York, The Macmillan Company. Volume I. Pp. xxvi + 586. $7.50.

Foot Notes to Evolution. David Starr Jordan. New York, D. Appleton & Co. 1898. Pp. xviii + 392. $1.50.

Text-Book of Physiology. Edited by E. A. Schäfer. Edinburgh and London, Young J. Pentland; New York, The Macmillan Co. 1898. Pp. xviii + 1036. $8.00.

Anatomy and Histology of the Mouth and Teeth. I. Norman Broomell. Philadelphia, P. Blakiston's Sons & Co. 1898. Pp. viii + 428. $4.50.

Text-Book of Histology. Philipp Stöhr. Second American Edition translated from Seventh German Edition by Dr. Emma Billstein. Philadelphia, P. Blakiston's Sons & Co. 1898. Pp. xviii + 424. $3.00.

Human Anatomy. Henry Morris. Philadelphia, P. Blakiston's Sons & Co. 1898. Pp. xxix + 1274. $6.00.

Annual Report of the Roard of Regents of the Smithsonian Institution. 1896. Washington, Government Printing Office. 1898. Pp. xliii + 727.

Outlines of Industrial Chemistry. Frank Hall Thorp. New York and London, The Macmillan Company. 1898. Pp. xvii + 541. $3.50.

Fertilizers. Edward B. Vorhees. New York and London, The Macmillan Company. 1898. Pp. xiv + 335. $1.00.

Instinct and Reason. Henry Rutgers Marshall. 1898. Pp. xii + 574. $3.50.

Erratum: On page 675 above first column, line 33, for *Wabash* Creek read *Walnut* Creek.